JOURNAL of FARM ECONOMICS

American Farm Economic Association Meeting
August 23-26, 1959
Ithaca, New York

THE AMERICAN FARM ECONOMIC ASSOCIATION

Volume XLI AUGUST, 1959 Number 3

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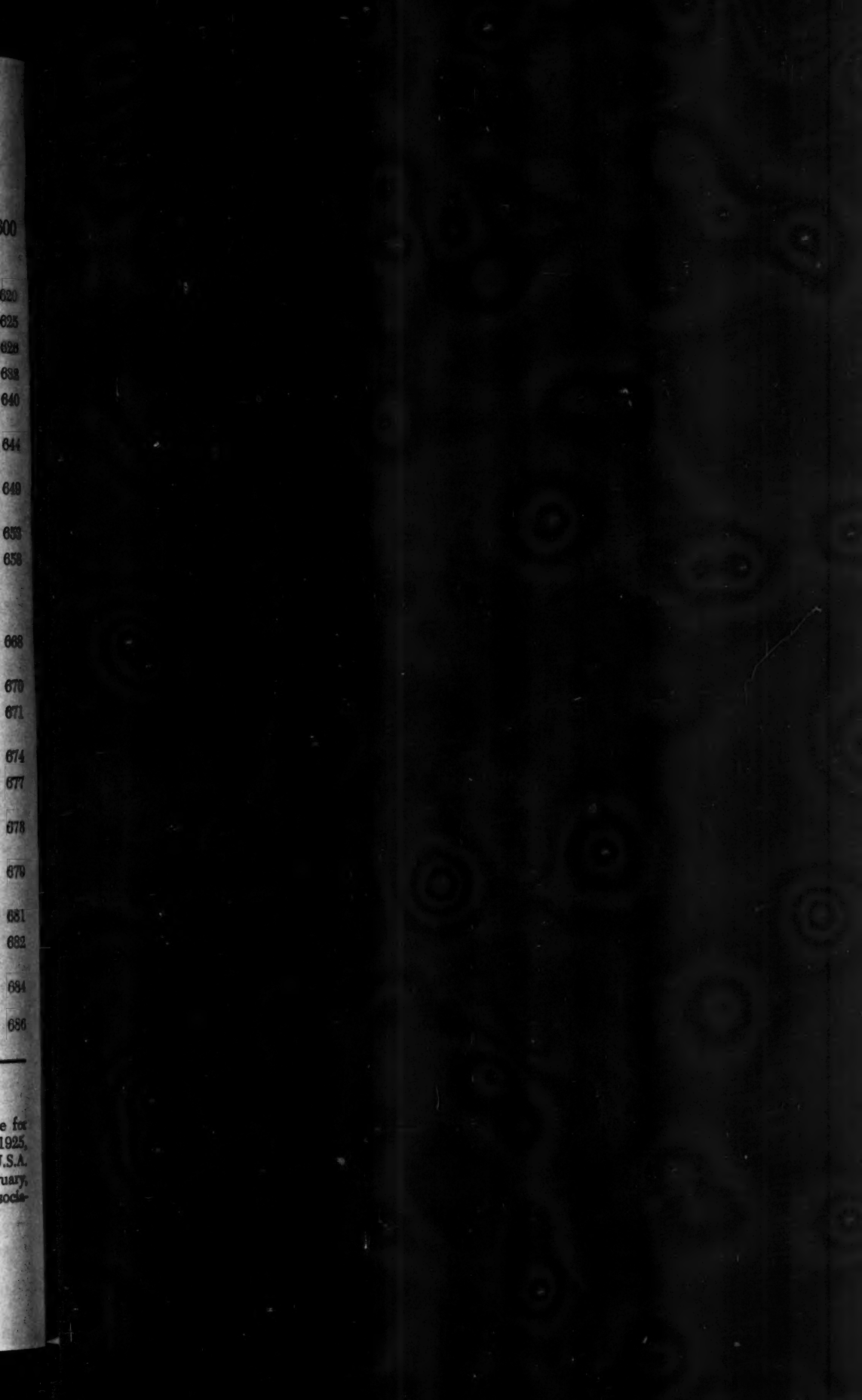
Price: $9 per year, this issue $2.00

Entered as second class matter at the post office at Menasha, Wis. Acceptance for mailing at a special rate of postage provided for in the Act of February 28, 1925, paragraph 4, section 412, P.L.&R., authorized November 27, 1931. Printed in U.S.A.

THE JOURNAL OF FARM ECONOMICS is published five times a year during February, May, August, November and December by The American Farm Economic Association. Yearly subscriptions $9. Published at Menasha, Wisconsin.



JOURNAL
OF
FARM ECONOMICS

Volume XLI AUGUST, 1959 Number 3

AGRICULTURE IN AN UNSTABLE ECONOMY REVISITED

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MORE than a decade has passed since T. W. Schultz wrote *Agriculture in an Unstable Economy*. It has been a decade during which the forces in the agricultural economy have shown the book prophetic and at the same time have proven it inadequate. It has also been a decade in which numerous agricultural economists have contributed significantly to our theories and knowledge regarding the agricultural economy. Some, including Professor Schultz, have attempted to set their analysis within the framework of the total economy, but none have emphasized the effects of cyclical instability to the extent of *Agriculture in an Unstable Economy*.[3]

It is the author's belief that further investigation of the cyclical relationships between agriculture and the non-agricultural economy is needed. Until such relationships are clear, lasting solutions to the current and prospective problems of the agricultural industry may be more a matter of accident than design. This paper will review current opinion regarding some of these relationships and hypothesize some different ones which appear more consistent with new facts.

One aside is necessary by the way of introduction. Professional interest in recent years has been strongly diverted to the problem of "economic development" or growth, partially because of our national concern with underdeveloped countries and partially because of our "low-income" farm problem. It appears that this has diverted attention from the cyclical economic forces affecting the farms which produce the bulk of the food and fiber in the United States. Growth or progress in our economy is largely measured by gains in real income per capita. Such gains occur at

[1] Journal paper number 2387 of the Michigan Agricultural Experiment Station.
[2] The author is indebted to many of his colleagues for helpful suggestions during the development of this paper, especially Glenn L. Johnson, James T. Bonnen, and William A. Cromarty.
[3] McGraw-Hill Book Company, Inc., New York and London, 1945.

an uneven rate. Periods of rapid gains are generally termed prosperity or expansion periods, and periods of little gain or perhaps losses are known as recessions or depressions. It is the hypothesis of this paper that many major movements in agriculture are closely related to these business cycles, which originate in a variety of ways and for a variety of reasons, and that too little analysis has been within this framework in recent years. This is why *Agriculture in an Unstable Economy* is the beginning point of this discussion.

Instability and the Demand for Farm Products

The general outline of the effects of aggregate changes in business activity upon the demand for farm products is now a part of the accepted doctrine of agricultural economists. Therefore, only a brief review is in order. This can be outlined as follows:

1. The aggregate level of income and employment varies from time to time. These variations result in sharp changes in the aggregate demand for farm products.
2. The export demand for farm products varies significantly depending upon the economic and military situation in the major importing countries. Increases in domestic demand tend to coincide with increases in export demand, partially because of our periods of very high employment have usually been during wars, and partially because there is a high degree of interdependence between the level of activity in our economy and that of major importing nations.
3. The price elasticity of demand for food is low at the retail level and even lower at the farm level.
4. As a result in the low elasticity of demand for food the changes in aggregate demand tend to cause large changes in the ratio of farm prices to nonfarm prices over the business cycle, assuming that the supply curve of farm products shifts more slowly than does the demand curve. The income of farm operators from farming is highly correlated with business expansions and contractions.

The validity of these observations relating to the effects of instability on the demand for farm products is generally accepted and has been verified by research in recent years. However, one additional aspect of the relationship of instability to the demand of farm products has only been put forth recently and its implications have not yet been adequately analyzed.

Schultz in his *Economic Organization of Agriculture* suggested that the income elasticity for nonfarm services attached to the marketing of food tends to be higher than for the raw product component of food at retail.[4]

[4] T. W. Schultz, *Economic Organization of Agriculture*, McGraw-Hill Book Co., Inc., 1953, Chpt. V.

This has been tentatively verified by Bunkers and Cochrane[5] and by Daly.[6] However, none of these authors have examined the consequences of this upon the price elasticity of demand for farm products.

If the income elasticity for marketing services is higher than for the farm products component of food at retail, during periods of expanding real income expenditures for these services will expand more rapidly than for the farm product. Historically, these services (marketing margins in lay terms) tend to be very "sticky" when demand is contracting, i.e., the income elasticity is higher during expansions than during contractions in demand. If the price elasticity of food at retail remains unchanged over time, this means that the price elasticity of farm products necessarily declines over time. Thus, shifts in aggregate demand and/or shifts in the supply of agricultural products will induce greater price fluctuations than previously.

With this, our picture of the effects of instability upon the demand for farm products is more or less complete. It is a picture which shows large shifts in the aggregate demand for food at retail; shifts which are magnified progressively over time by the differential income elasticity for marketing services and the raw farm product. It shows the agricultural industry has been subject to large changes in the price received for a given output depending upon the position of the demand curve. And it portends even greater farm price instability for the future in an uncontrolled market for agricultural products.

Instability and the Output of Farm Products

While the treatment of effects of instability upon the demand for farm products in *Agriculture in an Unstable Economy* has stood the test of time, the treatment of the effects of instability upon output has fared less well. Schultz said: "Agricultural production in the aggregate responds slowly, or not at all, to the changes in economic expectations associated with business fluctuations."[7]

It is true that the general course of farm output in the United States has been upward for as long as we have records. However, the path of the increases has been irregular, and it is this irregularity that is crucial to the discussion. Most agricultural economists either have measured

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[5] E. W. Bunkers and Willard W. Cochrane, "On the Income Elasticity of Food Services," *Review of Economics and Statistics*, May, 1957, p. 211.

[6] Rex F. Daly, "Demand for Farm Products at Retail and the Farm Level" paper presented at the joint meetings of the American Statistical Association and the Econometric Society, Atlantic City, New Jersey, Sept. 12, 1957.

[7] T. W. Schultz, *Agriculture in an Unstable Economy*, Chpt. VI, p. 131. My point is not that the available data were interpreted incorrectly in 1945, but that conditions in agriculture have changed and new data are available.

changes in output over long periods or recognize 1929-1932 as the only downturn in economic activity we have had, or both. Such inadequate understanding of the movements of the general economy causes one to overlook the path via which agricultural output has actually expanded. Table 1 shows periods of general business expansions and contractions since 1910. *During nine of the ten periods of business expansion farm output was higher at the end of the period than at the beginning.* The only exception was during World War I. In six of the ten periods of business contraction farm output was lower at the end of the period than at the beginning, in one it was unchanged, in two there were minor increases, and in one a substantial increase. The large increase (1913-14) and one modest one (1944-46) came when the export demand for farm products was expanding greatly, even though domestic business activity was undergoing a mild decline. Most of the changes in output associated with the business cycle are due to the changes in crop output per acre as shown by Columns 2 and 3 of Table 1. This is to be expected since

TABLE 1. PERCENTAGE CHANGES IN MEASURES OF AGRICULTURAL PRODUCTION DURING PERIODS OF BUSINESS CYCLE EXPANSION AND CONTRACTION, 1911–56

Periods of Business	Gross National Product (1)	Index of Net Farm Output (2)	Index of Crop Production per Acre (3)	Index of Livestock and Livestock Product Output (4)
Expansion				
1911–1913	8.7	1.7	1.3	3.3
1927–1929	11.7	2.8	−2.5	1.3
1954–1956	14.3	4.6	5.9	4.3
1924–1926	14.3	7.4	3.8	1.4
1921–1923	19.9	11.3	8.2	12.1
1946–1948	23.0	6.1	5.0	−4.0
1949–1953	41.2	6.9	4.0	10.7
1932–1937	55.2	7.9	11.4	−6.2
1914–1919	100.3	0.0	−7.2	3.1
1938–1944	148.1	22.8	12.9	32.9
Contraction				
1910–1911	0.3	−3.3	−5.1	1.7
1948–1949	0.0	−2.9	−6.6	6.2
1953–1954	−0.7	0.0	−1.9	2.6
1944–1946	−1.0	1.0	5.2	−3.8
1923–1924	−1.1	−1.4	0.0	−1.4
1926–1927	−1.9	−1.4	−1.2	2.7
1913–1914	−3.8	10.0	9.2	1.6
1937–1938	−6.2	−3.7	−3.4	3.9
1920–1921	−18.4	−11.4	−15.1	3.1
1929–1932	−44.0	2.7	0.0	5.2

Source: Col. 1—Op. cit.
Col. 2—*Changes in Farm Production and Efficiency, 1956 Summary*, United States Department of Agriculture, p. 8.
Col. 3—Ibid., p. 17.
Col. 4—Ibid., p. 8.

crop production is annual and more dependent upon those inputs which are variable in the short run. Of course, over the long run livestock output is dependent upon crop production even though it does not show the same cyclical variation.

This relatively crude analysis is supported by the more refined analysis of Dr. Geoffrey Moore of the National Bureau of Economic Research. He reported:

> Another finding is that the relation of crop production to business cycles has become more systematic during the historical period we cover. During 1867-96, a comprehensive index of crop production conformed positively (i.e., moved in positive rather than inverse relation) to business cycles in only 3 instances out of 13; during 1895 to 1920, it conformed positively in only 5 instances out of 13; but during 1919-49 it conformed positively in 12 instances out of 13. It appears that the relatively high level of conformity in recent decades is attributable more to the behavior of average crop production per acre than to aggregate acreage.
>
> Tentatively we conclude that business cycles have come to exert a more powerful (though still far from dominant) influence upon crop production, and that this is effected largely through such control as the farmer has over yields per acre. The increasing use of fertilizers, machinery, and other items that involve large cash outlays and directly affect yields has operated in this direction. Although there is evidence that farmers "respond" to business cycles by shifting acreage among crops, these shifts tend to cancel out in the aggregate; not so with yields per acre. In any event the evidence seems to put a heavy burden of proof upon those who believe the farmers make a special effort to increase output during depressions via either acreage or yield changes.[8]

Even if farm output contracted by the same percentage annually during periods of declining demand as it expanded annually during years of increasing demand, total output at present would be well above 1910. This is because there are more than twice as many years included in the periods of expansions as in the periods of contractions. This, of course, is why we can have long-run economic growth even though there are periods in which per capita output and income declines. To date those who have noticed these changes in annual farm output have usually attributed them to weather. Thus, we are forced to examine the apparent effects of weather upon farm output again; but fortunately this time we have some additional information hitherto unavailable.

Cycles, Farm Output, and the Weather

Until recently the remark that "Everyone talks about the weather and no one does anything about it" applied nicely to agricultural economists. Professor Cochrane wrote a critical comment regarding *The Economic Organization of Agriculture* which suggested by its title that Professor

[8] Business Cycle Research and the Needs of Our Times, 33d Annual Report, National Bureau of Economic Research, Inc., May 1953, pp. 35-36.

Schultz had recently discovered the phenomenon of weather.[9] In a footnote in this comment Cochrane said[10] "Interestingly enough weather seems to be cooperating with man in reducing price instability in agriculture. The price decline in 1921 and the low prices in the middle 1930's were moderated by poor growing seasons, and bumper crops were forthcoming over the period 1945-48."

Professor Schultz made a similar statement in *Agriculture in An Unstable Economy*.[11] The Department of Agriculture seems impressed by the same coincidences in their report *Long Range Agricultural Policy* for the Committee on Agriculture, House of Representatives of March 10, 1948.[12]

However, recent research done by James Stallings[13] and Glenn Johnson at Michigan State University has done much to improve our knowledge of the effects of weather upon crop production in the United States.

An explanation of the index developed by Stallings will not be attempted in this paper. However, the index is used in Table 2 to show the apparent direction of the influence of weather during the beginning and ending year of business cycles. It is compared with the change in the index of the yield of 18 field crops, which presumably is the factor in farm output subject to the influence of weather.

Table 2 suggests that factors other than the weather must be used to account for the fluctuations in crop yields per acre which appeared to be associated with the demand for farm products. It is worth noting the sharp rises in yields from 1921 to 1923, from 1932 to 1937, from 1938 to 1944, and from 1949 to 1953 occurred in spite of a decline in the index of weather conditions. On the other hand, yields barely held at the same level from 1923 to 1924, from 1926 to 1927, 1929 to 1932, and from 1937 to 1938 despite appreciable increases in the index of weather.

Thus, the index of influence of weather developed by Stallings does not support the conclusion that we always tend to get better weather during periods when the demand for farm products is high and farm income is improving. Instead, Stallings' data would more nearly support the hypothesis that factors other than weather are needed to explain the changes in crop yields which are associated with the cyclical changes in the demand for farm products.

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[9] W. W. Cochrane, "Professor Schultz Discovers the Weather," *Journal of Farm Economics*, May 1953, pp. 280-283.

[10] *Ibid.*, p. 282.

[11] *Op. cit.*, p. 41.

[12] *Ibid*, p. 43, 45.

[13] Currently Assistant Professor of Agricultural Economics, University of New Mexico.

TABLE 2. CHANGES IN FARM INCOME, CROP YIELDS PER ACRE, INDEX OF WEATHER, AND THE INFLUENCE OF FACTORS OTHER THAN WEATHER FROM THE FIRST TO LAST YEAR OF BUSINESS CYCLES 1910–56

Periods of Business	% Change in Net Farm Income	Change in Index of Crop Yield Per Acre[2]	Direction of Change in Yield/A	Change in Weather Index[3]	Influence of Weather	Influence of Factors Other Than Weather
Expansion						
1911–13	+ 9.6	75 – 76[1]	+	84.1– 76.7	–	+
1914–20	+ 88.9	83 – 86[1]	+	94.9–111.2	+	0 or –
1921–23	+ 30.5	71.4– 75.1	+	102.6– 98.5	–	+
1924–26	+ 11.3	74.4– 75.1	+	103.7– 95.0	–	+
1927–29	+ 7.0	77.6– 74.0	–	105.0– 97.2	–	0 or +
1932–37	+171.4	74.8– 84.4	+	106.0–101.5	–	+
1938–44	+185.9	83.2– 95.0	+	108.7–101.1	–	+
1946–48	+ 6.3	97.7–108.6	+	100.8–120.6	+	– or 0
1949–53	+ 1.5	99.2–107.1	+	92.0– 90.3	–	+
1954–56	– 1.0	108.4–122.7	+	90.0–108.2	+	0 or –
Contractions						
1910–11	– 8.7	79 – 75	–	106.4– 84.1	–	+ or 0
1913–14	– 6.3	76 – 83	+	76.7– 94.9	+	0 or –
1920–21	– 45.0	80.3– 71.4	–	112.3–102.6	–	– or 0
1923–24	– 1.1	75.1– 74.4	–	98.5–103.7	+	–
1926–27	– 0.8	75.1– 77.6	+	95.0–105.0	+	–
1929–32	– 69.2	74.0– 74.8	0	97.2–106.0	+	–
1937–38	– 18.3	84.4– 83.2	0	101.5–108.7	+	–
1944–46	+ 22.8	95.0– 97.5	+	101.1–100.8	0	+
1948–49	– 14.2	108.6– 99.2	–	120.6– 92.0	–	0 or +
1953–54	– 12.2	107.1–108.4	+	90.3– 90.0	0	0 or +

[1] Crop production per acre since data prior to 1920 not available for crop yields per acre.
[2] Computed from Table 33 and 35, pp. 50 and 51, Agricultural Handbook 118, Vol. 2.
[3] Computed from James Stallings' *Indexes of the Influence of Weather on Agr'l. Output*, Unpublished Ph.D. thesis, Michigan State University, 1958, Table 9, pp. 89–95.

Inputs and the Business Cycle

The existing opinion regarding the stability of inputs used in agricultural production can be neatly expressed by the statement: "But the hard facts are that total inputs employed by farmers have remained almost constant since 1920, and the modest changes that have occurred seem to be random in nature, or inversely correlated with price level changes."[14]

Unfortunately Professor Schultz's most recent book added little to the understanding of this particular problem. In it he said: "The quantity of inputs committed to farm production from one year to the next is the most stable economic variable in agriculture. It is doubtful that one could find another major variable in the entire economy that is as steady—come depression followed by recovery, or mobilization, war and peace, or bumper crops, or a run of bad yields."[15]

[14] W. W. Cochrane "Additional Views on Demand and Supply," *Agricultural Adjustment Problems in a Growing Economy*, Iowa State College Press: 1958, p. 96.
[15] T. W. Schultz, *The Economic Organization of Agriculture*, Chapter XII, p. 210.

These two statements (or generalizations drawn from them) have been widely quoted and have contributed to the assumption that farm output is completely unrelated to the demand for farm products. The result has been a series of conclusions that increases in farm output occur without reference to economic or other conditions and will continue to do so. These increases are attributed by various people to technology, quality of labor, specialization, weather, and various other causes. It will not be argued that all of these have not had an important effect upon the output of specific crops and in the aggregate. However, it does appear that these explanations ignore the importance of the following hypotheses.

1. Inputs for agricultural production do vary over the business cycle but the increase in inputs during periods of expanding demand are far grater than the contractions of inputs during periods of declining demand.
2. These changes in inputs, together with other structural changes that occur in agriculture more readily during certain phases of the business cycle, are important contributions to changes in total agricultural output which are associated with the nonfarm business cycle (which, of course, means the demand for farm products) and the association is causal rather than coincidence. In addition, because of the steadily increasing importance of purchased inputs in agriculture, input variations will probably become an increasing cause of output variation in the future.

Each of these hypotheses fly in the face of presumed statements of fact by some of our best known economists. Therefore, some attempt will be made to substantiate the hypotheses with factual evidence which previously had been either overlooked or misunderstood.

The reasons for the apparent error in these earlier statements seem to arise from two sources: (1) a failure to measure inputs used in agricultural production adequately, (2) an inadequate understanding of the differences in the nature and characteristics of different inputs, and (3) the use of incorrect time spans or too long a period, which accidentally covers the cyclical variations.

Turning to the second item briefly a potentially useful theoretical framework for dividing inputs into different classifications depending upon their acquisition and salvage values to the farm sector has been made by Glenn Johnson and will not be repeated here.[16] His framework suggests that because of differences in acquisition costs and salvage values among input categories that the employment of these different inputs

[16] G. L. Johnson, "Supply Function—Some Facts and Notions," *Agricultural Adjustment Problems in a Growing Economy*, p. 80. D. G. Johnson, "The Supply Function in Agriculture," *American Economic Review*, Vol. 40, 1950, also treats this same general area of resource use over the cycle.

will vary depending upon economic conditions. These theoretical concepts should help identify some of the input categories in which measurement difficulties are greatest.

The measures currently in use do not provide adequate measures of the inputs used in agricultural production,[17] especially on a year-to-year basis. Conceptual problems as well as index number problems are great and the current index of inputs has both.

First, the current index of inputs combines inputs and expenses and the two are not the same. Two examples will suffice. Taxes are an expense not an input. Varying tax rates will not change the physical production function, since they are not involved in it. Interest payments are in the same category. More serious is the use of depreciation as a measure of machinery input. Depreciation is clearly an expense item, but it will not measure the input of machinery services going into the production of farm products except under very special circumstances.[18,19] This problem might be less if machinery purchases varied little from year to year, but as will be shown later they vary greatly.

Farm labor is considered to be the largest single input into agriculture, even though its use has declined sharply.[20] However, the problems of measurement of actual labor input become nearly insurmountable. About all that can be said with certainty is that changes in the index of labor input for agricultural production that is commonly used *does not measure* the actual year-to-year changes in the hours *actually* spent producing farm products. The derivation of this index is explained in a recent publication of the Department of Agriculture which said: "The series of man-hours of labor used in farming are built up by individual farm enterprises by applying average man-hours per acre of crops and per head or unit of production of livestock to the official estimates of acres and numbers reported by the Agricultural Estimates Division, AMS."[21] This measure of

[17] By current index is meant the index of inputs used by Schultz in *Economic Organization of Agriculture,* Chapter VII, and by Cochrane in "Conceptualizing the Supply Relation in Agriculture," *Journal of Farm Economics,* Dec., 1955, pp. 1161-1175 and repeated in his *Farm Prices Myth and Reality,* Chapter 3.

[18] This problem may be compounded by the use of declining balance method of depreciation.

[19] If uncertainty and/or capital rationing cause farmers to not purchase machines unless their expected marginal value product is high enough to pay for them within a very few years, one would expect that the productivity of these machines would substantially exceed their total cost over the life of the machine. This merely says that the m.v.p. of capital in agriculture usually exceeds the interest rate, which is a common assumption apparently consistent with research findings.

[20] Thus, the base period becomes important in determining the inputs used in agricultural production. For a discussion of this see Loomis, Ralph A., "Effect of Weight Period Selection on Measurement of Agricultural Production Inputs," *Agricultural Economics Research,* Oct., 1957, pp. 129-135.

[21] Agricultural Handbook No. 118, Vol. 2, *Agricultural Production and Efficiency,* p. 12, 13.

labor does not appear to provide a valid basis for stating that inputs do not vary cyclically as have Cochrane and Schultz.

One gains relatively little by the use of either of the employment series for agriculture to measure labor input. About four-fifths of the workers in agriculture are family workers and there is no measure of whether they are planting crops or working on home improvements which may improve the quality of family living without contributing to farm output. Thus, we have no measurement of the extent of underemployment of family workers either from year-to-year or over time.

The two series on hired farm workers are not very helpful on year-to-year changes either. The Census series samples households and classifies workers by major place of employment, thus missing marginal variations in time spent in agriculture. The AMS series samples farm employers and counts everyone working on the farm even though he may be primarily employed elsewhere. However, this has only been true since 1925, since prior to that time the year changes were interpolations between census benchmarks.[22] While it may be true that the census series is a better measure of total employment trends as suggested by Schultz,[23] it would appear that the AMS series since 1925 is a better measure of marginal changes. Despite the sharp downtrend in the number of hired farm workers since 1925, the number of hired workers increased during four of the seven periods of business expansion (1924-26, 1927-29, 1933-37, 1946-48) even though nonfarm job opportunities were generally expanding during these periods. Two of the other three periods were wartime (1938-44, 1950-53) and the other was 1954-56 when farm prices and incomes were declining. On the other hand, the number of hired farm workers *never increased during a general business decline, even though nonfarm job opportunities were decreasing and farm wage rates declining relative to the price of other inputs.* Thus, the evidence is strong that farmers do attempt to vary the input of that portion of their labor input which costs them money (and therefore is more likely to be employed productively) by additions during periods when the demand for farm products is increasing and reductions when the demand is falling.

Even if we had an accurate measure of year-to-year changes in input of family labor, its use would not be expected to decline significantly during business downturns since its salvage value (opportunity costs) is essentially zero when there is unemployment.

The third largest input used in agricultural production is the input of capital items, which is generally measured by maintenance and depreciation. What we should be attempting to measure is the flow of services

[22] Agricultural Handbook No. 118, Vol. 7, p. 11.
[23] *The Economic Organization of Agriculture*, p. 106.

used in agricultural production during a given year. To start, the rapid change in the mix of services available makes the problem virtually impossible as an index number problem. In addition, depreciation does not measure either the items available for use as inputs or their actual use. Assuming that farmers generally buy machinery for use, the total physical stock of machines probably more nearly measures the annual flow of services available or used than does the depreciation. The difference can be seen by comparing these figures for tractors from 1920-1950. Depreciation on tractors rose from $118 million to $509 million[24] whereas the number of tractors on farms increased from 246 thousand to 3,394 thousand.[25] Even this fourteen-fold increase in numbers underestimates the increase in power available, since over the years the average horse-power ratings of tractors has been steadily increasing. For most other types of farm machinery and motor trucks the disparity between increases in depreciation and in stocks is even greater than for tractors. It is difficult to believe that farmers increased their stock of these capital items for reasons other than to increase the flow of current input services which may be used in agricultural production. Thus, it appears that changes in levels of current purchases are an indicator of year-to-year change in machinery inputs. This rests on the assumption that the major reason a farmer purchases a new machine is that it will maintain or increase output when combined with a given set of other resources on his farm.

As I have shown elsewhere farmers do vary their rate of expenditures upon tractors and machinery substantially from phase to phase of the business cycle.[26] Apart from war periods farmers generally have increased their physical purchases sharply during periods in which farm incomes were increasing and they generally have reduced purchases when farm incomes were declining. It would appear that these reductions in expenditures represent an attempt to reduce inputs, especially if they are deep enough and long enough so that total stocks of these capital items are reduced. However, once these machines are owned by the farm sector they will continue in use since their salvage value is below their marginal value product.

Turning to those expendable items used in farm production which are really inputs and are more adequately measured, we do find reductions in these items during periods of declining farm income. Inputs of purchased feeds (which contain nonfarm services as inputs), fertilizer, and petro-

[24] Agriculture Handbook 118, Vol. 3, p. 41.

[25] Agriculture Handbook 118, Vol. 2, p. 15. There is no reason to assume that tractors on farms are standing idle any greater proportion of the time than in the past. In fact, most innovations have been to increase the versatility of farm machines.

[26] "Agriculture and the Business Cycle," *Policy for Commercial Agriculture*, pp. 51-76.

leum, fuel and oil are often (generally) reduced during periods of declining farm income. In periods when they were not reduced the rate of increase was generally low. During periods when the demand for farm products was expanding, farmers have nearly always increased their inputs of these items at a very rapid rate.

The purpose of this section is not to quarrel with the current indexes of inputs used in agricultural production. It is to show that the method of constructing these indexes precludes their showing year-to-year variations which may have occurred, and to suggest that other data show that inputs used in farm production do vary with changes in the demand for farm products. This variation in inputs is one of the reasons farm output rises rapidly during periods when the demand for farm products is expanding and declines when it is declining. This is not to argue that increases in conventional inputs are the sole reason for the observed increases in output during periods of business expansion. Other contributors are specialization, improved technology, improved asset position due to capital gains, changes in the supply function of credit, and other factors. Although there is no time to develop the point extensively here, there is evidence that these effects are also associated with cyclical variations in agriculture and the nonfarm economy.

A large portion of new technology requires the acquisition of some physical item which embodies it, and specialization also usually requires purchases. Thus, when conditions are such that farmers are able and willing to buy these items and to combine them in certain ways, farm output increases rapidly. When conditions are such that farmers are unable or unwilling to buy more of these items the increase in output slackens, although since the salvage value of these items is low they usually are used as inputs and maintain output unless the total stock is depleted or unless there is a reduction in the use of other input items. In any case the expansion of output expected as a result of an increase in demand will exceed the reduction in output to be expected if demand goes back to its original level.[27]

Additional Information Needed

The hypothesis that has been advanced relating to the relationship between the cyclical changes in demand for farm products and the aggregate output of farm products has many implications for long-run agricultural policy. Before it can be accepted it must be further investigated and substantiated, rejected, or modified. Several avenues will contribute to this testing.

First, it has not been hypothesized that all changes in output can be

[27] See G. L. Johnson, *op. cit.* for the development of this point.

explained by changes in purchased physical inputs. It is evident, however, that a further work is needed at both the conceptual and measurement level on measuring agricultural inputs. Of course, much such work already is underway. In addition, more attention should be given to the measurement of inputs over shorter periods, specifically business cycles.

Additional theoretical work and measurement also is needed for other factors contributing to increases in aggregate farm output. Among them are the role of specialization, recombination of inputs, scale, technology, quality of the human agent, capital gains, the nature of the supply function for credit, and weather. In most cases it will be virtually impossible to separate the individual effects but, in any case, they should be analyzed to determine any cyclical relationships that may exist.

Perhaps the plea is not so much for a major shift in the things being studied as for a marked shift in the time span of our analyses. The long sweep of history or the experience of one severe cycle has relevance, but too little has been done to relate the specific movements in agriculture to the business cycles which through their rise and fall constitute the long sweep of economic growth in the United States.

Summary and Conclusions

This paper has attempted to put forth a hypothesis which suggests that changes in inputs have accounted for a larger portion of the changes in output than usually attributed to them. It appears that a careful examination of the underlying statistics supports the hypothesis.

Heretofore there has been widespread recognition of the impact of changes in general business activity upon the demand for farm products. However, it has been assumed that year-to-year changes in farm output were the result of variations in weather, with long-run increases in output independent of the business cycle. Further examination suggests that farm output may be associated with nonfarm economic activity which affects the demand for farm products. Evidence is advanced that changes in conventional inputs account in part for the changes in farm output.

As yet it is not possible to support the hypothesis with refined statistical analysis. Needed are further improvements in the measurement of the effects of weather upon crop output, improved measures of input used in agricultural production, and further investigation of the relevant salvage values of agricultural inputs over the business cycle. If, with these tools, the hypothesis put forth in this paper can be substantiated, an improved framework for our agricultural policy will have been established.

OBSERVATIONS ON MARKET STRUCTURES AND NATIONAL ECONOMIC DEVELOPMENT IN THE PHILIPPINES

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THE research reported here was stimulated by a paper by Professor Willard Mueller in which he suggests that market structure analysis is an undeveloped tool of economic growth theory.[1] Mueller made a convincing argument on why such analysis is important and analyzed the implications of the market structures found in several underdeveloped countries. As he points out, the structures of markets can be of strategic importance as an undeveloped country emerges into a market economy. "The very rate at which an exchange economy emerges is inherently paced by the performance of its marketing institutions."

This paper (1) furnishes data not generally available on agricultural market structures in the Philippines, (2) contains some observations on progress in agricultural industry segments, with reference to the goals of economic development, and (3) speculates on the market structures which might promote development at a more rapid rate.

Actually, the Philippines is a highly developed market economy in some economic segments, but in others it only is trying to emerge. Markets are highly commercial for exporting a few primary products, including semi-processed agricultural products and logs, crude lumber and minerals. Also among the highly commercial markets are those for importing of finished commodities required to meet the consumption and capital needs of the nation. Some markets for transportation, communication and services have reached an advanced stage of commercialization. The markets for factors of production and for processing and distributing rice and corn, the two principal corps for the domestic market, are far from primitive, though less advanced than the above.

On the other hand, the goal of economic development is to achieve greater reliance on manufacturing, particularly the processing of domestic raw materials, and on agriculture for the domestic market, through increased and more diversified production. The market structures implied by the above goal are still in a relatively primitive stage. The most desirable structure, in terms of number of firms, degree of concentration and integration, and the government policies to encourage such development may well be quite different from what is needed in the more developed economic segments. This is not to say that the relatively developed segments do not require considerable attention. These also need to increase productivity; in many cases there is evidence of stagnation, in all cases

[1] Willard F. Mueller, "Some Market Structure Considerations in Economic Development," *Journal of Farm Economics*, May 1959, pp. 414-25.

there are problems of investment and problems of income distribution.

The objectives and the program for economic development were set forth in the report of the U. S. Economic Survey Mission to the Philippines, headed by Daniel W. Bell.[2] When the Philippine Congress in November 1950 requested that a U. S. Operations Mission be assigned to the Philippines, many of the recommendations in the Bell Mission report became national policy and the U. S. promised cooperation in a program calling for loans or grants which totaled about $250 million.[3] The National Economic Council of the Philippines proceeded to draft a five-year plan which proposed to implement the recommendations of the Bell Mission Report.[4]

Basically the program was oriented around the dollar exchange problem, since exchange reserves had declined rapidly after independence, notwithstanding some $2 billion the U. S. had pumped into the economy as war reparations and so on. Imports for consumption were to be sharply reduced, with the expectation that items formerly imported would be supplied or substituted by local production and manufacture. It was argued that exchange saving was equally as important as exchange creation.[5] Agricultural exports were to receive little additional resources in form of dollar exchange, except for replacements. These exports were expected to hold constant, there being little prospect for expanding export demand. It was expected that domestic agriculture would be expanded to supply domestic demand for products then imported chiefly from peso resources, except that dollars would be used to import fertilizer and insecticides. Growth in the economy was expected to come primarily from manufacturing, including food and fiber processing.

It is worth noting that the Bell Mission report and the American program were aimed directly at developing the Philippine economy so that it could function without primary reference to the commercial benefit of the United States. In this respect the program we suggested was far more positive than any previous one during 1898-1946.

Since independence the new government has participated heavily in some markets, and has adopted direct exchange and pegged currency controls since 1949. However, it has been relatively lax on regulation, service and incentive programs.

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[2] Daniel W. Bell, *et al., Report to the President of the United States Economic Survey Mission to the Philippines*, Washington, October 9, 1950.

[3] President Quirino and William C. Foster for President Harry Truman, *Memorandum of Agreement*, November 14, 1950.

[4] Anonymous, *The Five-Year Economic and Social Development Program for FY, 1957-61*, adopted by the National Economic Council on January 3, 1957, Office of National Planning, NEC, Republic of the Philippines.

[5] Walter Krause, "Economic Development in the Philippines," *National Economic Council Monograph*, April 1956.

Nature of Production and International Trade in Agricultural Products

Of around six million hectares planted in 1955, about 65 per cent was in rice and corn (for food), nearly 20 per cent in coconut, 4 to 5 per cent each in sugar cane and abaca, 2 to 3 per cent each in sweet potato and banana. Less than 1 per cent each was in tobacco, mango bean, egg plant, tomatoes, peanuts, gabi and coffee. Farmers also produced some fish, chickens and eggs, hogs, carabao meat and milk, and various indigenous fruits and vegetables, all chiefly on a subsistence basis.

At least 75 per cent of all exports was agricultural, most of which was accounted for by coconut products, sugar cane products, abaca and rope, and logs and lumber. Agricultural and forestry products, chiefly processed, accounted for about 40 per cent of total imports. Total domestic exports amounted to 785 million pesos, while imports amounted to 1,095 million pesos.[6]

Structural Characteristics of Markets

Data on structural characteristics of markets are pieced together from various sources, the accuracy and consistency of which often leave something to be desired. Number of firms and concentration within industries are compiled chiefly from a directory that resulted from a survey by the National Economic Council of the Philippines with technical advice and financial assistance from the International Cooperation Administration.[7] This was the first thing of its kind ever compiled in the Philippines and the classifications often are not too clear. This directory shows names of key establishments, location, classification by industry, number of employees, and type of ownership. Key establishments are those with five or more employees. The NEC-ICA survey also made counts of the total number of establishments exclusive of stalls in market places and business operated as household enterprises,

In an underdeveloped economy a large percentage of the production, processing and marketing activities are carried on by persons without any regular business establishment. To furnish some indication of the extent of such activity, an estimate was made of the number of workers in each industrial segment from the classifications in the Survey of Households (Table 1).[8] The numbers not in establishments were derived by comparing data from the two above sources.

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[6] *Handbook of Agriculture*, Department of Agriculture and Natural Resources, Republic of the Philippines, 1957; *Seventh Annual Report, 1955*, Central Bank of the Philippines, Republic of the Philippines, 1956.

[7] Anonymous, *Directory of Key Establishments in the Philippines in Selected Non-Agricultural Industries Employing Five or more Workers During 1955*, A Special NEC-ICA Survey, Department of Labor, Republic of the Philippines, 1956.

[8] Anonymous, *The Philippine Statistical Survey of Households Bulletin, May 1956*, Office of Statistical Coordination and Standards, NEC Labor Force Series No. 1, Vol. 1, December 1956.

TABLE 1. EMPLOYMENT AND NUMBER OF ESTABLISHMENTS BY INDUSTRY CLASSIFICATION, PHILIPPINES, 1955

Industry	Not in Establishments[a]	In Establishments of Les Than 5[b]	In Establishments of Over 5	Totals
Total:				
Workers	1,736,108	267,615	415,359	2,419,082
Establishments	—	107,046	15,235	122,281
Manufacturing:				
Workers	790,923	24,395	210,682	1,026,000
Establishments	—	9,758	7,789	17,547
Transportation, communication and storage:				
Workers	182,649	3,335	47,016	233,000
Establishments	—	1,334	650	1,984
Wholesale and retail trade:				
Workers	534,996	180,018	65,986	781,000
Establishments	—	72,007	5,364	77,371
Mining and quarrying:				
Workers	None[c]	83	26,342	26,425
Establishments	—	33	65	98
Construction:				
Workers	169,546	1,588	15,866	187,000
Establishments	—	635	124	759
Forestry and logging:				
Workers	None[c]	1,083	15,281	16,364
Establishments	—	433	293	726
Fishing:				
Workers	57,994[d]	4,605	14,362	76,961
Establishments	—	1,842	509	2,351
Banks, insurance, real estate and other services:				
Workers	None[c]	51,383	11,386	62,769
Establishments	—	20,553	207	20,760
Electricity, water and gas:				
Workers	None[c]	500	8,438	8,938
Establishments	—	200	234	434
Not elsewhere classed:				
Workers	—	628	—	628
Establishments	—	251	—	251

[a] Employment of workers not in establishments was estimated by deducting those in establishments from data on employment by industry from the Household Survey—Labor Force cited elsewhere.

[b] Employment in establishments of less than 5 employees was assumed to average 2.5 employees per establishment.

[c] For mining, forestry, banking, and utilities, it was assumed that no individuals could be employed outside establishments in view of the technology in use.

[d] On fishing the number of employees not in establishments was estimated at the same percentage as the ratio between the number not in establishments to those in establishments for manufacturing, transportation, etc., wholesale and retail trade and construction.

Over-all concentration in the manufacturing industries appears somewhat lower in the Philippines than in the United States. In 1955, the largest 50 and largest 100 establishments employed[9] 19 per cent and 25

[9] The Philippine data are calculated as a percentage of total employment in key manufacturing establishments. Concentration ratios measured by employment tend to understate the measurement by shipments, judging from American industries.

per cent respectively of all workers employed in key establishments.[10] In 1954, the 50 and 100 largest American manufacturing concerns accounted for 23 per cent and 30 per cent respectively of total manufacturing sales. However, as subsequent analysis will show, when particular industries are compared, concentration ratios are higher in Philippine industries than in roughly comparable American ones. Over-all concentration in manufacturing in the Philippines is low because of the relatively large number of manufacturing industries which perform very elementary functions and into which entry is easy, because capital and technology requirements are low.

Industry Numbers and Concentration

To measure the numbers and degree of concentration of particular industries the chief data source was the directory of key establishments (more than five employees).[11] Table 2 shows the number of firms and concentration ratios for selected industries that process and handle agricultural products. It includes processing firms, exporters and importers, wholesalers, retailers, and warehousing firms. Many of these, however, are not specialized to agricultural products.

In general, the index of concentration is highest in the most highly developed industries. The largest 20 establishments have 80 per cent or more of the employees in nearly all the relatively developed industries where the technology is capital intensive. Less than 10 of these industries are made up of as many as 25 companies.

In food and fiber processing, the industries in which the largest 20 establishments have concentration ratios of 80 or more are: grain mill products, sugar, desiccated coconut, poultry and cattle feeds, starch, alcohol, breweries, soft drink, all the textiles, tanneries, vegetable oil and copra cake. The hypothesis that these are the most highly developed tends to fit the writer's observation as to the acceptability and availability of the products. The feeds are high priced since all the grains could be sold for food, but the processing is efficient.

Coffee, tobacco curing and drying, slaughter, sausage and meat pack-

[10] *Concentration in American Industry*, Report to the Senate Judiciary Committee, 85th Congress, p. 11.

[11] These key establishments may be viewed as the firms in the national market. Each is a firm in the sense that it is a managerial unit for operating purposes and usually for pricing purposes. Names of establishments in this directory usually fail to show the name of the owner. Concentration ratios, therefore, tend to be understated as here shown, but it is a generally accepted fact that most wealth is owned by a small per cent of the population (say one-tenth of 1 per cent), although there are no good quantitative data on this. These key establishments usually are located in Manila, or in provincial capitals. These are the trade centers referred to by the Stanford study, with the best roads, ports, and airports, motorized transport and telephone or telegraphic communication with other sellers and/or buyers. The smaller establishments, homecrafts, market stalls, individual fishermen-merchants, and so on, are really not in the same market and, therefore, not in the same industry, for practical purposes.

ing, dairy products other than ice cream, and fruit and vegetable canning and preserving all have high concentration ratios, though they are not highly developed. Large quantities of each of these classes of product

TABLE 2. NUMBER OF KEY ESTABLISHMENTS AND TOTAL WORKERS IN AGRICULTURAL PROCESSING AND HANDLING INDUSTRIES; CONCENTRATION RATIOS BASED ON PERCENTAGES OF TOTAL WORKERS IN VARIOUS INDUSTRIES EMPLOYED BY LARGEST FOUR, LARGEST EIGHT, AND LARGEST 20, PHILIPPINES, 1955

Industry	No. Establishments	No. Employees	Largest Four	Largest Eight	Largest 20
	(number)		(per cent industry employees)		
Food manufacturing:					
Slaughter houses	3	31	100	100	100
Sausage manufacturers	7	113	72	100	100
Meat packing and preserving	6	109	87	100	100
Dairy products manufacturing—ice cream and ices	52	594	24	38	60
Dairy products manufacturing—all other	6	61	75	100	100
Fruits and vegetable canning and preserving factories	14	2,735	96	98	100
Fish canning and preserving factories	35	451	36	50	75
Grain mill products manufacturers	2	84	100	100	100
Rice mills	760	7,879	4	7	12
Corn mills	146	1,926	14	21	43
Bakeries	1,501	17,826	4	6	9
Sugar centrals, sugar refining plants and sugar packing plants	56	23,360	33	59	91
Cocoa, chocolate and confectionery factories	82	2,784	32	54	74
Misc. food processing factories	8	60	50	100	100
Noodles manufacturers	74	1,122	13	25	56
Coffee roasting and grinding factories	27	620	52	72	92
Desiccated coconut factories	10	5,763	69	98	100
Poultry and cattle feeds manufacturers	11	211	67	89	100
Starch and its products manufacturers	12	678	68	89	100
Food seasoning and other food products manufacturers	134	1,858	10	17	40
Grand Total	2,946	68,265	12	23	37
Beverage industries:					
Alcohol distilleries	10	378	69	96	100
Wine and native liquor distilleries	62	1,873	32	48	71
Breweries	1	2,500	100	100	100
Soft drink factories	26	3,567	53	78	98
Grand Total	99	8,318	48	64	78
Tobacco manufactures:					
Cigars, cigarettes and other tobacco products manufacturers	91	10,084	40	62	83
Leaf tobacco curing	8	905	89	100	100
Grand Total	99	10,989	36	57	81
Textiles:					
Textile spinning and weaving mills	57	5,946	78	84	93
Knitting mills	21	1,481	47	75	99.5
Ropes, twines and net manufacturers	45	1,061	47	62	80
Jute mills	3	1,502	100	100	100
Other miscellaneous fiber manufacturers	6	218	93	100	100
Grand Total	132	10,208	49	62	78

TABLE 2 (*Continued*)

Industry	No. Establishments	No. Employees	Largest Four	Largest Eight	Largest 20
	(number)		(per cent industry employees)		
Miscellaneous manufacturing:					
Sawmills and planing mills	271	21,698	28	40	53
Tanneries	26	539	60	75	92
Fertilizer manufacturers	3	39	100	100	100
Vegetable oil and copra cake manufacturers	36	2,462	60	72	93
Ice plants	92	1,045	25	33	48
Wholesalers and retailers:					
Coop. marketing associations	88	2,839	52	61	76
General wholesale merchants	493	6,307	11	16	23
Importers and exporters	248	8,818	21	38	59
Abaca, maguey, ramey and textile wholesalers	106	1,246	21	32	48
Coconut, rice and other farm products, except tobacco leaf wholesalers	252	6,305	42	47	57
Tobacco leaf and tobacco products wholesalers	36	602	37	57	80
Beer and soft drinks wholesalers	13	158	52	76	100
Groceries and food stuffs wholesalers	172	2,181	17	23	37
Miscellaneous wholesalers	53	606	23	34	59
General retail stores	1,577	13,972	4	5	8
Groceries and food retail stores	384	3,401	6	10	16
Abaca, copra, corn and tobacco retailers	53	413	11	19	40
Grand Total	3,475	46,848	8	11	18
Warehouses:					
Bonded warehouse	4	38	100	100	100
Cold storage	7	605	96	100	100
Warehouses	4	227	100	100	100
Grand Total	15	870	88	94	100

Source: Computed from *Directory of Key Establishments in the Philippines in Selected Non-Agricultural Industries Employing Five or More Workers During 1955*, A Special NEC-ICA survey, Dept. of Labor, Republic of the Philippines, 1956.

are imported and sold at high prices. However, it is significant that in each of these industries the products of the largest firms either sell at prices relatively close to prices of imports or completely replace imports of the items they made. Examples follow:

Standard Brands and ABC America's Best have local branch factories that make instant coffee from domestic coffee beans. These enjoy consumer acceptance on par with imported coffees, whereas most domestic packs are less preferred than imports.

Cigars tend to be of high quality and enjoy prestige in export trade. The cigar industry to no small extent is dominated by the Tobacalera Corporation which bought the stock when the Spanish Government monopoly of the tobacco and cigar industry was dissolved in 1881.[12]

[12] Mariano E. Gutierrez, "Tobacco Research, U. S.-Philippines Tobacco Trade Reciprocity, Home and World Markets," *Agricultural Yearbook, 1949-50*, The Philippine Association of Agriculturists, Manila, 1951, pp. 167-188.

Although the entry into production of cigar tobaccos and manufacture of cigars was not restricted thereafter, quality continued high. Domestic cigarettes fail to compete successfully at 20 centavos per package with imported American brands at 1.25 pesos to 1.50 pesos per package (100 centavos = 1 peso). When Virginia and Maryland tobaccos were introduced in 1921 and cigarette manufacture began, in an attempt to compete for the market created by American cigarettes, there were no quality controls and no grade standards. The domestic cigarette industry never developed to compare with the cigar industry under the Spanish Government monopoly, which for 100 years covered all stages of production, harvest, manufacture and trade. The Republic's price support program to encourage Virginia tobacco production has resulted in enormous surpluses of low quality tobacco.

The two evaporated milk plants are subsidiaries of Consolidated Dairy Products Company, Seattle, and General Milk Company,[13] a subsidiary of Carnation-Pet. These two companies produced 1.2 million cases of filled evaporated milk in 1958, out of a total consumption of about 4.2 million cases; the balance was imported. The locally produced filled milk sells for 28 to 35 per cent less at retail than United States evaporated milk.

Among fruit and vegetable canners, only three firms have more than 20 workers. One of these is the Philippine Packing Corporation, a subsidiary of California Packing Corporation, which employs 2,500 of the 2,735 employed in this industry group. Cal Pac packs one-half of its total pack of pineapple in the Philippines from an integrated plantation-factory, and with a small proportion of this supplies the entire domestic demand for canned pineapple.

The industries with low concentration ratios fit into four categories:

(1) Those with labor intensive technology but which are relatively developed, which include ice cream and ices, noodles manufacturers, bakeries, food seasoning, and so on.

(2) Those which are relatively developed and tend to be capital intensive, but are old industries with a large market, including rice and corn milling and most of the wholesaling and export-import industries.

(3) Those in which the advanced technology is capital intensive but in which the investment is not being made properly to develop the industry. The most notable of these is lumbering, though abaca, coconut and tobacco wholesalers could belong in this group. The lumber industry has not the skilled labor nor technology for correctly sizing, kiln drying, matching the grain, or producing fine veneers. Most fine furniture is imported; veneer is imported from Japan where it has been made from Philippine mahogany logs.

(4) Those in which government participation has affected concentration.

[13] Anonymous, "Charges Consolidated, General Milk Choking Off Evap. Exports," *Dairy Record*, February 4, 1959.

In this group would go rice and corn milling, and some wholesaling and retailing industries. The Agricultural Credit and Cooperative Finance Administration (ACCFA) has built 200 or more rice mills and warehouses, working through local cooperatives. The National Marketing Corporation (NAMARCO) was established to break the "monopoly of the Alien Merchant."[14] This government corporation handles imports of foods, plumbing equipment, building fixtures and resells to selected stores. The National Rice and Corn Corporation (NARRIC) was established primarily to import those commodities and resell them at politically set ceiling prices in retail stalls.

Concentration is much greater in food processing industries of the Philippines than in those (matched as closely as possible) for the United States (Table 3). In nearly half of the Philippine industries the concen-

TABLE 3. NUMBER OF INDUSTRIES IN WHICH THE FOUR, EIGHT, AND 20 LARGEST ESTABLISHMENTS ACCOUNTED FOR VARIOUS PERCENTAGES OF WORKERS, 25 FOOD AND RELATED AGRICULTURAL PROCESSING INDUSTRIES, PHILIPPINES, 1955

Number of Firms	80–100	70–79	60–69	50–59	40–49	30–39	20–29	Under 20	Number Industries
	Percentage of industry workers								
Four largest	6	2	3	2	1	4	2	5	25
Eight largest	11	2	1	3	1	2	2	3	25
20 largest	15	3	1	1	3	0	0	2	25
Average number firms in industries where 20 largest have various concentration ratios	10	60	52	74	124	—	—	1,131	

Source: Table 2 above.

tration ratios for the largest eight companies fall in the 80-100 bracket. On the other hand, in about one-eighth of the industries the ratios fall in the under 20 bracket. For the United States there are a considerable number of industries in each bracket of ratios. Further indication of the kind of competition that may be expected is that the average number of firms in these industries is quite small compared with the United States; competitive behavior of the large firms is more probable where the number of firms is large, even if concentration ratios are high.

Indications of the relative sizes of the national market in the two countries are that the United States has about nine times as many food processing firms serving seven times as many people who have national income nearly 90 times as great.

In contrast to concentration in food processing, the ratios are no more than half as great in the food retailing industry as for the United States

[14] Benjamin F. Estrella, "Importation Policies and Distribution Procedures of the NAMARCO," *Economic Research Journal*, September 1957, pp. 96-98.

(Table 4). For the Philippine industry with 384 companies, the ratio for the largest four is 6.0, for the largest eight is 10.0, and for the largest 20 is 16.0. For the U.S., industry of 319,395 firms, the ratios are 20.6, 25.6, and 31.0, respectively.[15]

Ease of Entry

The types of restriction on entry may be grouped under five headings. They are: (a) direct government controls, including the exchange rationing of the Central Bank, and the impact of a pegged currency ratio; (b) laws discriminating against alien management and alien capital; (c) capital and technological requirements, including credit; (4) uncertainties caused by the behavior of government corporations in the same business; and (e) lack of market news, grades and standards, inspection,

TABLE 4. NUMBER OF INDUSTRIES IN WHICH THE FOUR, EIGHT, AND 20 LARGEST FIRMS ACCOUNTED FOR VARIOUS PERCENTAGES OF SALES, 30 FOOD AND RELATED AGRICULTURAL PROCESSING INDUSTRIES, UNITED STATES, 1954

Number of Firms	80–100	70–79	60–69	50–59	40–49	30–39	20–29	Under 20	Number Industries
	Percentage of industry shipments								
Four largest	1	3	3	4	5	4	7	3	30
Eight largest	5	4	4	5	3	3	5	1	30
20 largest	11	5	4	3	3	3	1	0	30
Average number firms in industries where 20 largest have various concentration ratios	105	146	956	1,021	1,388	2,501	4,334	—	

Source: Computed from Willard F. Mueller, "The Changing Structure of the Food Industries," Agricultural Marketing Clinic, Michigan State University, March 10, 1959.

inadequate concentration of farm production and so on. Each of these will be described briefly.

Probably the most serious problems of entry are those which arise out of direct government controls. Since 1949 when exchange controls were established the chief problem which faces most entrepreneurs has been getting enough dollar exchange allocated by the Central Bank to purchase machinery, equipment and imported supplies and raw materials. Even branches of foreign concerns face essentially the same controls. The National Economic Council has established a formula on the basis of which the President instructed the Central Bank to administer priorities for dollar exchange.[16] This formula includes such elements as number of Filipino laborers that will be employed, proportion of domestic raw ma-

[15] U. S. data from Leon Garoian, "Economic Changes in the Structure of Food Retailing, 1940-57," University of Wisconsin Ph.D. Thesis, 1959.

[16] "The Five Year Economic and Social Development Plan," *op. cit.*, pp. 254-257.

terials that will be used, essentiality of the product in terms of dollar earning or dollar saving, extent to which capital subscribed is from Filipino compared to "alien" sources and so on. Although the elements of the formula may appear reasonable in view of nationalistic objectives, the net effect of applying the formula often has to discriminate against capital intensive industries.

Exporters must turn their dollar receipts in to the Central Bank and receive pesos only at the pegged rate of two to the U. S. dollar (there are some minor exceptions). New York and Hong Kong rates vary up to nearly four to the dollar. Exporters, on the other hand, have no preference in purchase of dollar exchange to buy tractors, machinery, fertilizers, insecticides, and other such producers' goods.

A major problem of entry into retailing has been the discrimination against aliens which arose out of the nationalization of the retailing industry in 1949, giving alien partnerships and corporations 15 years from that date within which to liquidate their enterprises.[17] All aliens in retail trade must face restrictive licensing provisions. In 1946 Congress enacted a law limiting occupancy of stalls in public markets to Philippine nationals.

Restrictions on capital repatriation are said to hinder the growth of foreign capital investment, although the limits set by the Central Bank appear fairly high. Many such laws probably were aimed at the Chinese who live in the Philippines, but the effect may be to discourage investment of capital from any foreign source. Government spokesmen say they welcome the foreign purchase of bonds and other non-equity securities, but foreign capital may be reluctant to come in where the investors have no voice in management. The heavy dependence of the economy on foreign capital, especially from the Chinese, is suggested by Table 5 which shows that nearly one-fifth of all investment during 1945-56 came from foreign sources.[18]

Capital requirements are lowest in the services (aside from utilities) followed in order by wholesale and retail trade, mining and manufacturing, judging from the average capital paid in per start (Table 6). This reflects the net effect of various government policies and bears little observable relation to the economies of scale or other economic principles.

The impact of these barriers to entry has varied by industry segment. Facilities for processing and handling the export crops, copra, sugar, and abaca, as well as innovation on farms, may have been retarded because of the pegging of the peso at a lower ratio to the dollar than world rates. Exchange rationing as administered may have discouraged mining, lumbering, tuna fishing and canning, partly because the technology necessary

[17] Avelino B. Lim, "Restrictive Features of Philippine Commercial Policy and Their Effects on Investments," *Economic Research Journal*, June 1957, pp. 9-13.

[18] The heavy U. S. government loans and grants would be reloaned by the Philippine government and show up as Philippine capital.

TABLE 5. INVESTMENT FROM 1945 TO JUNE 1956, BY NATIONALITY OF INVESTORS AND FORM OF BUSINESS ORGANIZATION, PHILIPPINES

Source by Nationality	Single Proprietorship	Partnership	Corporate
		million pesos	
Total	1,062.7	274.4	288.1
Filipino	796.0	95.1	229.4
Chinese	248.0	150.6	32.5
American	9.4	11.3	17.1
Others	8.3	16.7	9.2

Source: Shubert S. C. Liao, "Contribution of Chinese Enterprises in the Economic Development of the Philippines," *Economic Research Journal*, Vol. IV, No. 2, September 1957, pp. 71-77.

to develop these industries is capital intensive, and the capital goods and managerial skills must be largely imported. Probably entry into wholesaling and retailing has been discouraged chiefly because of the laws discriminating against aliens. Uncertainties caused by lack of coordinated policies among the government corporations NARRIC and ACCFA have handicapped those two agencies and very likely discouraged entry in rice and corn storage by private entrepreneurs.[19] The activities of NAMARCO may have had a similar impact on importers and retailers. Entry into the essentially new industries of vegetable packing, meat packing, dairy proc-

TABLE 6. CAPITAL INVESTMENTS OF NEWLY REGISTERED FIRMS CLASSIFIED BY KIND OF INDUSTRY, 1955–56

Kind of Industry	Number Firms		Average Capital Paid in per Farm	
	1955	1956	1955	1956
			(pesos)	
Total	6,016	7,961	18,411	19,365
Agriculture (farming)	47	32	60,660	36,375
Forestry, livestock & fishing	75	67	35,493	70,224
Metal mining	23	42	15,870	24,857
Non-metallic mining	7	11	7,143	11,818
Manufacturing	1,339	1,734	25,285	22,241
Construction	57	57	27,754	20,807
Electricity, gas and water	11	12	46,091	24,167
Wholesale and retail trade	3,790	5,392	12,708	15,310
Banks and other financial institutions	48	28	118,542	104,536
Insurance	23	22	27,522	93,318
Real estate	64	41	81,625	206,122
Transportation and storage	123	113	28,195	39,434
Commercial & business services	177	165	10,684	10,436
Recreation and personal services	232	245	16,457	20,082

Source: Central Bank, *op. cit.*, p. 92.

[19] John D. Black, "Philippine Palay and Rice Price Policy and Program," USOM/Philippines, December 1, 1954; Hugh L. Cook, *et al.*, "Philippine Rice Production and the National Economy, An Analysis of the Situation and Suggested Program," USOM/Philippines, ICA, Manila, January 1958.

essing, and so on, has been slow because of the lack of social overhead investment in such services as market information, grades and standards, improved regulation of public transportation, and extension services. The high capital requirements for integrating so as to furnish all these services for the packing firm, as well as to obtain concentrated farm production of the necessary quantity and quality and to develop a market for domestic packs, has been a further barrier. The money market has not furnished the necessary credit for such new enterprises, though it might make credit available for a large corporate concern.

Some types of labor-intensive manufacturing which required little or no imports of machinery or materials have not been affected except during occasional periods of time when bank credit was rationed. Such things are the manufacture of jeepney and bus bodies, from wood and oil drums; crude furniture manufacture; earthenware; small fishing canoes from tree trunks and cottage woven cloth; bolos from broken car springs, and so on. The number of new starts in the manufacturing segment of the economy has been greater than in any other industry grouping except wholesale and retail trade, and perhaps higher than the number would have been without controls (Table 6). Whether these were the most productive uses of resources in terms of diversifying the economy and wise use of exchange is another question which this paper can barely touch upon.

Textiles, flour milling, steel fabrication, and others have been boosted beyond what they probably would have been without controls. Cooperative rice and corn milling and warehousing have grown faster because of government credit.

Product Differentiation

Product differentiation takes several forms, many of which are somewhat different from what would be found in a developed economy.

(1) The 20 major importers and exporters for whom the concentration ratio is 59 are especially favored oligopolists in sale of foreign brands. For some types of consumer goods, the foreign brands have a great prestige, especially the American brands. This is because most of the manufactured imports for 60 years have come from the United States and American brands have been advertised more. The prestige of the foreign label remains in spite of the great wave of nationalism, because most local manufactures are not yet produced to quality standards. This gives a unique differentiation; the traditionally imported finished goods are the chief ones about which the consumer is quality conscious. Actually the modifying effect on monopoly profits which in the United States would be exerted by the middle classes, with their massive purchasing power, to which most oligopolists would shape their price policies, is not present because there is almost no middle class.

Types of goods traditionally imported are canned vegetables, and meats and fruits to a lesser extent; cigarettes; coffee; whiskey; textiles; styled wearing apparel; household appliances; furniture; automobiles; and so on. Prices of these are high and profit margins are probably high also.

(2) Some items have been domestically manufactured to high standards so long that although consumers are quality conscious they do not prefer imported brands. These are not major items among consumer expenditures of any income class. They would be cigars, sugar, rum, beer, men's shoes, men's clothing, straw hats, canned pineapple, and so on. In general, these classes of goods are those which foreign firms, because of cheap labor and abundant raw materials, have found it profitable to establish local branches to manufacture. Many of these are labor intensive industries, with some notable exceptions. Some of these items are made to export standards. Prices are moderate though the ratio of costs to prices probably is low likewise.

(3) On the other hand, there is little quality consciousness on such items as fresh fruits and vegetables, fresh meats (except imports) milk (except evap.), eggs, rice, corn, and so on. Although there is much differentiation, it is not based on prestige, quality or advertising. Most stages of marketing for these would correspond to the monopolistically competitive market structures which Mueller reports exist in many underdeveloped countries. Typically, he says, there are a relatively large number of wholesalers and retailers selling differentiated products or services. He refers to several things which encourage this differentiation, all of which are present in the Philippines. They are: the immobility of buyers and sellers which exaggerates locational differentiation; the considerable reliance on credit by many buyers and sellers which invites credit differentiation, segmentation of the population into economic and social caste systems which provides unique opportunities for differentiation; inadequate market information which permits differentiation based on market ignorance. All of these factors provide the demand conditions conducive to monopolistic competition.

These conditions also apply in the assembly markets for many farm products. (Among the exceptions would be fresh fruit and vegetables and fish which are sold through municipal markets not unlike our farmers' produce markets in which there probably is keen competition.) Under such conditions, "the individual bargaining transactions . . . approach the nature of individual exchanges." Price variations are tremendous: rough rice prices vary from 7:00 pesos to 12:00 pesos per cavan at any one time among the islands, and at a given location will vary equally as much within the year. Although these demand conditions are conducive to monopolistic competition they tend to be offset by the low ratio of capital to labor to enter marketing, for example, to buy rough rice. Any buyer with a few hundred pesos and a vehicle can buy rough rice and haul to

a warehouse or a mill; nevertheless, the buyer also can lose heavily for lack of market information and because of the whimsical behavior of government buying and importing organizations, specifically the ACCFA and the NARRIC. The Chinese middlemen are reputed to be the only ones who can make money on rice and corn under these conditions, perhaps because they have superior methods for exchanging information and a developed sense of working together. As Mueller concludes, given the above demand and entry conditions, marketing margins are larger than if differentiation were less, though probably few of the middlemen are making excess profits.

The monopolistically competitive case also would apply to land and water transportation. Yet the more mature economies have long recognized that competition must be regulated in transport.

Among the 351 bus companies the concentration ratio for the largest 20 is 48. Among the 67 trucking companies the same ratio is 64. The principal inter-island fleet consists of about 140 vessels, chiefly from converted war surplus. These ply among 255 ports, most of which are in poor state of upkeep.

On the other hand, the railroad and airline industries are monopolies. The government owns the two railroads and part of the airline stock. The Philippine Air Line has a monopoly on scheduled domestic air service and on the airways communications system.

An excellent study has been made of Philippine domestic transport by Stanford Research Institute under NEC-ICA contract.[20] Although this was not a "market structure" study, it did make general conclusions about the conduct and performance of the firms in each of the transportation industries.

Of the conditions of competition, this study says:

> Domestic water transportation is characterized by intense, chaotic competition. Ship operators are free to institute or suspend service on their own volition. . . . Standards of service are not established by governmental agency. Widespread discrimination exists in rates through rebates, discounts, and other practices. Rate regulation has been ineffective . . . large shippers and consignees use the competitive situation to force rate and service concessions not available to others.
>
> . . . On many routes excess ship capacity exists. Bunching of sailings creates periodic pier congestion. Lack of regulation of entry into service impedes the introduction of new capital into the industry since investments are not protected from uneconomic competition.
>
> Seasonal overloading of passengers is a common practice. Safety and sanitary regulations are frequently violated.

[20] Anonymous, *An Economic Analysis of Philippine Domestic Transportation, Vol. I, Introduction; Conclusions and Recommendations for the Entire Study and an Action and Investment Program*, Contract Research Report for NEC-ICA, Stanford Research Institute, Menlo Park, California, January 1957, pp. 28-42.

Land Transportation

After the liberation . . . to satisfy the immediate requirements, a large number of underfinanced individuals were granted temporary certificates to operate army-surplus converted trucks . . . a chaotic competitive condition which the public regulatory agency was completely unable to control. . . .

Only in a few regions have better-financed and more efficient operators been able to establish, often through individual competitive practices that would not be countenanced in most countries, a semblance of order and adequate service and safety standards. . . .

Prevailing rates are generally considerably below those authorized. . . . Subterfuges to avoid payment of local registration fees are widespread. Failure to pay gross receipts taxes costs the national treasury large sums each year. There is no clear and consistent policy with respect to granting franchises, and actual service requirements are given scanty attention in authorizing new route services.

The Money Markets

For the traditional economic activities, the money markets could be viewed as highly developed. There are enough banks, sufficiently large with adequate peso reserves, with branches widely located and yet centralized into a banking system, to provide competition for borrowers and to finance the larger traditional enterprises that can offer traditional collateral. Much of the financial activity is concerned with financing the production and primary processing of the export commodities, especially sugar, and with distribution of the imported commodities, especially the larger wholesale houses and retail stores in the chief distribution centers. There is a traditional excessive concentration in real estate and trade. Just as in most of Asia, the financing of rice and corn production, of the thousands of small sari-sari stores, fishermen, and small manufacturers is carried on by Chinese merchants.

In terms of development objectives, however, the organized money market continues inadequate, despite various government credit programs to supplement commercial banks. The chief inadequacies of the money markets are their failure: (1) To finance types of enterprise for which the bankers have no actuarial experience and on which the uncertainties may be great or returns may be low in the short run. Examples are food and fiber processing and market development, production of citrus, cacao, coffee, livestock and vegetables. (2) To finance small farmers with no collateral except their crop, at lower interest rates to improve their competitive position in marketing and to increase their productivity. This occurs in traditional as well as new enterprises.

Essentially the problem centers on the terms of credit.[21] Recognizing this the government has established several agencies. Some of these are ACCFA, previously mentioned, the Rural Banks Administration, the

[21] The problem of bringing savings out of hoards and into productive use is probably less than in many underdeveloped countries.

Rehabilitation Finance Corporation, the National Resettlement and Rehabilitation Administration, and the Industrial Development Center.

The operations of the chief lending institutions is suggested by reference to Table 7. Loans for farm production are the second largest class of loan for the "other banks" and the largest for RFC, the Rural Banks, and NARRA. The greatest volume of these loans is for the more familiar crops which are usually secured by real estate.

Essentially the IDC influence is on terms of credit through regular banks by loan guarantees, and in making dollar exchange available to certain new enterprises, especially small and medium-sized ones. In the food and fiber industries its greatest influence has been on textiles.

TABLE 7. LOANS GRANTED BY SELECTED FINANCIAL INSTITUTIONS CLASSIFIED BY PURPOSE, PHILIPPINES, 1955

	Other Banks N=160	RFC N=8	ACCFA (Facomas) N=319	Rural Banks N=40	NARRA	GSIS and Manila Pawnshops
			Thousands of pesos			
Total	765,100	71,903	40,500	6,718	1,500	83,928
Agricultural	175,600	24,196	40,500[a]	4,590	1,500	—
Commercial	307,700	None	—	1,311	—	—
Industrial	104,700[b]	17,836[c]	—	176	—	702
Real estate	56,400[d]	23,221	—	—	—	9,605
Public utility	11,700	—	—	—	—	—
Others	109,000[e]	6,650	—	641	—	73,616[f]

[a] About 14 million for rice warehouses and warehouse loans.
[b] About 80 million for manufacturing.
[c] Six million for processing agricultural products.
[d] About 25 million for construction.
[e] About 25 million for consumption.
[f] About 67 million for consumption.

Sources: Compiled from Central Bank of the Philippines, *op. cit.*; Fourth Annual Report of the Rural Banks Administration, Central Bank of the Philippines, 1956; Organized Land Settlement in the Philippines, NARRA, A Terminal Report, USOM/Philippines, ICA, Manila, March 1958.

Critical examination of the annual reports of these agencies shows that since their establishment the terms of credit has moved the bulk of their loans toward the same kinds of risk as is taken by the commercial banks. RFC has made long term development loans, but requires traditional forms of collateral, either land or the traditional crops. ACCFA has become more and more a rice milling and trading agency, with crop loans having declined from 83.0 per cent of the total in fiscal 1952-53 to 29 per cent in 1956-57. NARRA has been unable to finance its newly settled farmers beyond the first year, or to secure credit for them from any other agency because the land title is tied up as collateral for the initial NARRA loan, and the farmers do not have the production record at their new location which could serve as a basis for an ACCFA loan. This is all the more

important because the new lands to which the settlers have been transferred is best suited for livestock, cacao, citrus, or other corps that require long term investment.

Rural Banks have made progress toward easing the terms of credit, but analysis of their records shows that most of the loans are to traditional crops and industries. In 1956 the loans secured by real estate, bank deposits or crops in storage (traditional collateral) were only 47 per cent of the total, nearly half the loans were for over six months, the size of loan ranged from 177 to 849 pesos, and nearly one-fourth were "character" loans. However, 67 per cent of its loans went to traditional crops or to economic segments not concerned with agriculture. Since these banks loaned only 18.3 million pesos the amount going into the developing agricultural and food industries was pitiably small.

What Type of Market Structures and Organization Would Most Rapidly Promote Economic Development?

It seems logical to expect that the underdeveloped countries will have to learn to live with monopoly in the newly developing industries as one price of self-sufficiency. For industries with capital intensive technology, the minimum size for reasonable efficiency must be large. Since the size of the market is small, only a few firms of an efficient size can find the domestic market on which they may have to depend for several years. Such industries will save substantial exchange by developing and inducing the popular substitution of domestic products for traditional imports. Following the model of the sugar industry, these firms could be integrated into farm production, and into distribution and market development.[22] The integrators could be the larger farmers, say of 20 hectares or more, which group may be the neglected element in national development policy. A similar structure may well be the objective for the agricultural export industries of copra and abaca which have stagnated; innovation is needed.[23]

Because of the shortage of capital, skills, and sense of public value in government, new countries may have to expect that these highly concentrated industries will be essentially in private ownership, although perhaps subject to more public regulation than might be needed to assure performance for large numbers of firms. For other industries in which the problem is of a different kind, policies to make the market structures more

[22] Much of the argument could be applied here from Willard F. Mueller and Norman R. Collins, "Grower Processor Integration in Fruit and Vegetable Marketing," *Journal of Farm Economics*, December 1957, pp. 1471-1483.

[23] Moises M. Kalow, "The Philippine Coconut Industry," *Agricultural Yearbook, 1949-50*, The Philippine Association of Agriculturists, Manila, 1951, pp. 99-117; Feliciano M. Clara, "The Mosaic Disease of the Abaca Plant and the Cadang-Cadang Disease of the Coconut," *Agricultural Yearbook, 1949-50, op. cit.*, pp. 118-122.

competitive may be appropriate. These may include improvement of market information and the other requirements of an efficient exchange economy, as well as public policies lowering the barriers to entry.

Logically, it may be asked how well the market structures, which the government (with technical advice and financial assistance from the U.S. government) has endeavored to shape, have performed in terms of development objectives. Results are far from conclusive, partly because the present program has been in effect for less than a decade; moreover, because the measurement of trends is difficult, their interpreters may reach widely differing conclusions. These interpreters include both the extremely sanguine and critical.[24]

Whatever the evidence as to success of the direct government controls, it is worthwhile to note that even the Acting Director of the Exchange Control Department, Central Bank of the Philippines, strongly advocates that such direct control be only temporary and that more reliance be placed on incentives now on the books or to be developed.[25] Such incentives, according to Director Brinas would include income tax exemptions to new and necessary industries, protective tariffs, special excise taxes on exchange or on imports, and even direct subsidies, which have been used up to now chiefly in gold mining. To the list cited from Director Brinas more emphasis is needed on such highly essential things as grades and standards for agricultural products, weights and measures, inspection, market news, extension services, agricultural economics research, production and consumption credit, and removal of laws discriminating against aliens and non-Christians.

If, as implied above, economic development and high market concentration are inevitable concomitants, a continuing threat to successful developments under private enterprise is the hostility often created by such market structures. Because the very structures necessary for development are also potentially exploitative ones, we may expect continuing criticism of them by the populace; and, especially in democratically based governments, serious restrictions and obstacles to their success may result. Resolution of this reaction to privately promoted development may well be one of the most serious practical problems facing many underdeveloped economies which rely, at least in part, on private enterprise in their development programs.

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[24] Anonymous, *Cumulative Progress Report on the Joint Philippine-U. S. Economic Development Program, etc. as of June 30, 1957*, Office of Foreign Aid Coordination, National Economic Council, Republic of the Philippines, November 1957; P. B. Dionisio (1st Vice President, Producers and Exporters Association of the Philippines), "Increased Export Earnings," *Trade and Industry, The Philippines Herald*, January 1958, p. 16.

[25] Amado R. Brinas, "Investment Incentives in the Philippines," *Economic Research Journal*, Vol. IV, No. 1, June 1957, pp. 26-32.

THE VARIABILITY OF CONSUMER PREFERENCES*

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MORE than one reader—and author—of consumer preference studies has asked himself: "How reliable are these results? What is the effect of experience with a product upon consumer' preferences? What are the sources of variation?"

This experiment was designed to aid interpretation of consumer preference studies. The primary purpose of the experiment was to determine the influence of continued testing upon acceptability ratings and expressions of preferences among beef loin steaks. Secondary purposes were to measure the amount of variation in acceptability ratings among households eating the same loins and among loins from different carcasses as classified by grade and by an objective measurement of tenderness.

Experimental Procedure

A sample of sixty households were enlisted in the consumer panel. Four grades of beef were selected for this study. Comparisons were made between adjacent and non-adjacent grade groups: Choice-Standard$_2$, Good$_1$-Standard$_1$, and Good$_2$-Commercial Cow.[1] Standard and Commercial Cow were selected because they lack homogeneity—a fact established in previous studies[2,3]—and the two more expensive grades because retail stores handle these grades most frequently.

Twenty-four short-loin steaks, ¾ inch thick, were cut from each of 60 carcasses for use by the consumer panel.

Each carcass was paired with two other carcasses. Carcasses were paired by the grades indicated above and also by "like" and "unlike" shear categories.[4] As shown in Table 1, carcass A was judged by households

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* This experiment is a part of more comprehensive research being conducted by H. D. Naumann, Elmer R. Kiehl, Margaret Mangel, D. E. Brady, Max F. Jordan and the author. Contribution from the Missouri Agricultural Experiment Station. Approved by the Director. Journal Series No. 2000.

[1] Subscripts are employed for identification and do not indicate grade divisions. Details of the experimental procedure are described in Missouri Research Bulletin 676, and in Max F. Jordan, "Stability of Consumer Tastes for Beef," Masters Thesis, University of Missouri, 1958.

[2] V. James Rhodes, Elmer R. Kiehl, D. E. Brady, and H. D. Naumann, *Predicting Consumer Acceptance of Beef Loin Steaks*, Missouri Research Bulletin 651, 1958.

[3] Elmer R. Kiehl, V. James Rhodes, D. E. Brady, and H. D. Naumann, *St. Louis Consumers' Eating Preferences for Loin Steaks*, Missouri Research Bulletin 652, 1958.

[4] The Warner-Bratzler shear machine measures in pounds the force required to shear a core of cooked meat of one or one-half inch diameter, and thereby provides an estimate of meat tenderness. Originally "like" shear was defined as a mean shear difference of from 0 to 3 pounds inclusive; and "unlike" shear, from 6 to 9 pounds inclusive. However, the narrow range of shear values in the loins purchased made it impossible to maintain division at these levels.

1 and 2 against an unlike shearing carcass (B) and also against a like shearing carcass (C). However, carcass B was judged by 4 households: B was judged by households 1 and 2 against an unlike shearing carcass (A) and was also judged by households 3 and 4 against a like shearing carcass (D). Each carcass was generally evaluated in both shear groups.

Each household evaluated 12 replicate steaks from one loin and 6 replicate steaks from each of two other loins. For example, the two adults in household 1 received an A and a B steak the first week, an A and a C steak the second week, an A and B steak the third week, an A and a C steak the fourth and fifth weeks, etc., in a randomized order for a total of

TABLE 1. DESIGN FOR COMPARING CARCASSES

Unlike Shear Comparison			Like Shear Comparison		
Carcasses Compared	Households Judging	Total Times Judged by 4 Persons	Carcasses Compared	Households Judging	Total Times Judged by 4 Persons
A & B	#1 & 2	24	A & C	#1 & 2	24
D & E	#3 & 4	24	D & B	#3 & 4	24
F & C	#5 & 6	24	F & G	#5 & 6	24

12 weeks. Each steak was divided in half; the wife ate the two upper half steaks and the husband ate the two lower halves. One steak of each pair delivered was identified with aluminum rings.

While adults in household 1 reported preferences between A and B and between A and C, they did not compare B and C; therefore, a test of the transitivity of preferences among A, B and C is impossible.

The two adults each evaluated each steak on a hedonic scale with nine descriptive phrases ranging from "Like Extremely" to "Dislike Extremely."[5] Each adult also indicated a preference between the two steaks. The hedonic scale was later assigned numbers from 1 to 9 beginning with 1 for "Like Extremely" for purposes of analysis.

Variation in Ratings and Preferences Over Time

An improvement between the first and second replicates in the acceptability ratings of leaner loin steaks and a decline in the ratings of fatter steaks were noted in a recent eating test at Missouri.[6] The null hypothesis tested in the present study was: there is no trend of ratings or preferences over time.

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[5] For description of scale see David R. Peryam and Francis J. Pilgrim, "Hedonic Scale Method of Measuring Food Preferences," *Food Technology*, Symposium, September, 1957, pages 9-14.

[6] Rhodes, *et. al., op. cit.*, pages 37-41.

Acceptability Ratings

This null hypothseis was, in general, correct. The mean ratings of each grade for each replicate did vary considerably over time, but evidenced little or no consistent trend (Figure 1). The Good grade (both $Good_1$ and $Good_2$) possibly had a slight upward trend; ratings of both $Good_1$ and $Good_2$ moved generally upward after replicate seven; the mean of the last three replicates of $Good_1$ and $Good_2$ is higher than the mean of the first three replicates by about 0.5 of a point. Ratings of Commercial Cow moved somewhat lower than the ratings of the other grades which generally moved together fairly closely, although there were exceptions.

In these tests, the mean ratings of Good improved and the mean ratings of Choice declined from replicate 1 to replicate 2 as had occurred in the St. Louis experiment.[7] However, the large number of variations dur-

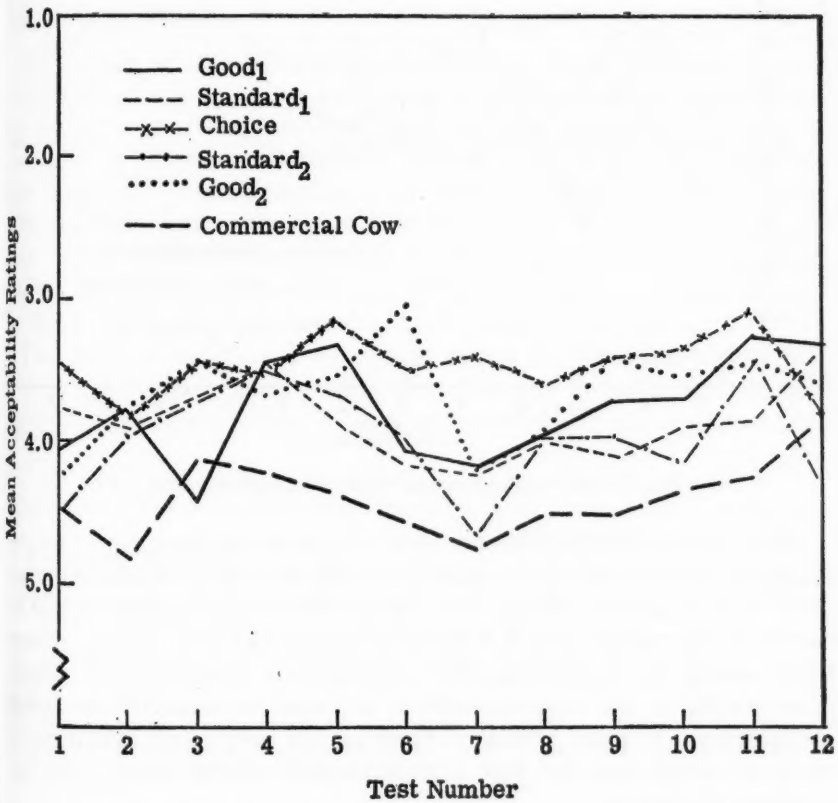

FIG. 1. MEAN RATINGS OF GRADES BY TESTS, EXPERIENCE PANEL.

[7] *Ibid.*

ing 12 tests suggests that a trend factor is of extremely little importance in explaining the variation from replicate 1 to replicate 2 in the two experiments. A detailed study of ratings of each loin by tests found only 5 loins with convincing evidence of trends, and they were distributed in 3 grades. At this stage of the investigation, the major cause of these variations between replicates apparently must be labeled "chance."

There was a very slight trend upward in the net preferences[8] for $Good_2$ over Commercial Cow (Figure 2). Aside from this very tentative indication of a trend, there was no other evidence of trends over time.

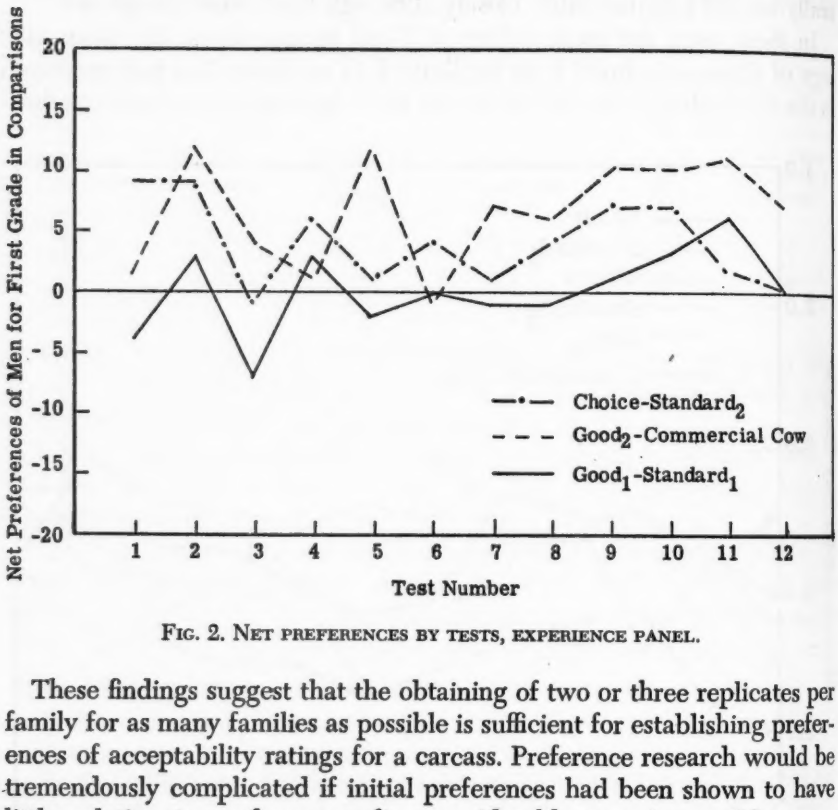

FIG. 2. NET PREFERENCES BY TESTS, EXPERIENCE PANEL.

These findings suggest that the obtaining of two or three replicates per family for as many families as possible is sufficient for establishing preferences of acceptability ratings for a carcass. Preference research would be tremendously complicated if initial preferences had been shown to have little relation to preferences after considerable experience. Of course, these results do not suggest results of attempts to "educate" or change preferences over time. Moreover, these results have other limitations in terms of sample size and type of experimental controls which limit far-reaching inferences.

[8] Net preferences for a grade were defined as the number of preferences for that grade minus the number of preferences for the other grade compared with it.

Variation Among Households Evaluating Same Loins

There are two related but somewhat different aspects to this problem of inter-household variation arising because of the experimental design. (1) Each of the 60 loins was consumed by either two or four households, so differences between or among households can be obtained for 60 loins. (2) Each of 30 pairs of households received samples from the *same three loins*. Thus, the results for three loins can be compared for each of these 30 pairs. It is possible for one household to rate one loin or even all three significantly higher than another household and yet to "rank" all three loins in the same order as the second household. Such an occurrence would indicate a "hedonic" effect (different hedonic ratings in general), which possibly reflects a difference in absolute acceptability but not in relative acceptability.

Acceptability Ratings

Differences in household means per loin for those evaluated by two families ranged from 4.83 to 0.33 and averaged 1.19. Differences between the highest and lowest household means per loin for those evaluated by four families ranged from 5.33 to 0.84 and averaged 2.10. The three biggest differences among families—5.33, 4.83 and 4.66—were all associated with Household 47 rating down severely all three loins tasted. It should be noted that each household mean was based upon twelve or six ratings and on only the ratings of the men. Differences in mean ratings of loins by households were significant for 25 of the 60 loins (Table 2).

There was complete rank agreement among the three loin means for 7 pairs of households, partial rank agreement for 14 pairs, and no rank agreement for 9 pairs of the 30 pairs of households evaluating three loins

TABLE 2. DIFFERENCES AMONG HOUSEHOLDS RATING SAME CARCASSES

I. Two Households Rating Same Carcass	No. of Carcasses	
	*Sign. Diff.	Not Sign. Diff.
$Good_1$	5	5
$Standard_2$	1	9
Commercial Cow	6	4
II. Four Households Ratings Same Carcass		
$Good_2$	6	4
$Standard_1$	3	7
Choice	4	6
	25	35

*95% level of significance of F ratio.

each. Thus the mean acceptability scores per loin indicate that about one-fourth of the households ranked the same three loins in the same order, while another one half of the households ranked them in somewhat the same order.

Part of the household disagreements in ranking can be accounted for by very similar ratings of each household for all three loins. There were differences of 1.0 point or more in the three means for each household in only 10 of the 30 pairs. Within these 10 households were 4 of the 7 cases of complete agreement, and 2 of the 9 cases of no rank agreement. The amount of agreement of households in rankings is positively related to the magnitude of the acceptability differences among the products compared.

Preferences

Preferences for each pair of 60 pairings of loins were given by two households. A total of 12 preferences were expressed for each household by husband and wife. For example, in the comparison of carcasses A and B by households 1 and 2 (Table 1), household 1 recorded 4 preferences for A while household 2 recorded 9 preferences for A. Thus there was a difference of 5 in the preferences for carcass A between households 1 and 2. It is apparent that the maximum possible difference in preferences for a loin between any two households would be 12. The median difference in preferences was 2, the mean differences was 2.6, and the range was 0 to 9. For six loins the difference was 7 or more, and for 23 of the 120 loins it was zero.

For 24 of the 60 comparisons preferences were enough different between households to suggest "majority disagreement." That is, in these 24 cases of disagreement a majority of one family's preferences were for one loin in the pair while a majority of the other family's preferences were for the other loin or else were evenly divided between loins. However, differences of only one—such as 6 to 5 versus 5 to 6 or 6 to 6—were not considered as "majority disagreements."

The same conclusion of much agreement but a significant amount of disagreement must be made for preferences as for acceptability ratings.

Variation Within Households

Standard deviations of acceptability ratings by loins within households ranged from zero to 3.29. Of the 180 household-loin evaluations, there were 60 standard deviations under 1.00, 98 from 1.00 to 1.99 and 22 from 2.00 to 3.29. Standard deviations exceeding 1.0 are rather large. A recent relatively inexperienced panel tasting steaks under laboratory controls at this Station had somewhat smaller standard deviations. It should be realized that rating scales are sensitive enough to reflect environmental

conditions as well as product conditions.[9] Therefore, more variation would be anticipated from a household panel tasting over a 12 week period than from a panel tasting two weeks under laboratory conditions.

The coefficient of simple correlation between loin means and loin standard deviation was 0.63 (95% confidence limits of 0.45 and 0.77). This suggests that an important factor affecting the magnitude of loin–and household–standard deviations was the position of the means on the 9-point scale. The large means of 4, 5 and 6 were in the middle of the scale where there was the most "room" for variation in individual ratings. The lower means of 2.62 to 3.99 were associated generally with smaller standard deviations as there was less "room" for variation at the higher end of the scale.[10] However, only about 40 percent of the variation in magnitude of standard deviations is probably explained by the size of the means. Individual household variation has already been shown to have been a causal factor.

Variation Among Carcasses as Related to Grade and Shear

Seventy percent of acceptability ratings for all loin steaks fell within 3 categories–"Like Very Much," "Like Moderately" and "Like Slightly." The modal rating for all grades was 3–"Like Moderately." Of the 30 steak ratings of "Dislike Extremely" given by men, Commercial Cow received 57 percent; Good, 27 percent; Standard, 17 percent; and Choice, 0 percent.

The poorest Choice loin received a mean rating of 3.96 (Figure 3). Percentages of loins in the leaner grades with poorer ratings than 3.96 were Good, 20; Standard, 45; and Commercial Cow, 60. The best rating of any loin was for Standard No. 44 with a mean of 2.63. The same large over-lapping of grades and the same general relationship of grade to acceptability is indicated as in the St. Louis experiment.[11] Over-all rating means of grade were quite close with a noticeable break between Standard and Commercial Cow.

Mean percentages of respondent preferences (men and women) were greater for the "higher" grade in each grade comparison except $Good_1$-$Standard_1$ (Table 3).

Three loins were preferred in all 12 tests by all persons eating them.

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[9] Peryam and Pilgrim, *op. cit.*, pages 10-11.

[10] Dr. Lyle Calvin of Oregon State College first suggested this explanation to the writer.

[11] Rhodes, *et. al., op. cit.*, pages 12-19. A great over-lapping of Choice and Good grades as to shear measurements and laboratory panel scores in an experiment involving about 200 animals has recently been reported. Sylvia Cover, G. T. King, and O. D. Butler, *Effect of Carcass Grades and Fatness on Tenderness of Meat from steers of Known History*, Texas Exp. Sta. Bul. 889, 1958.

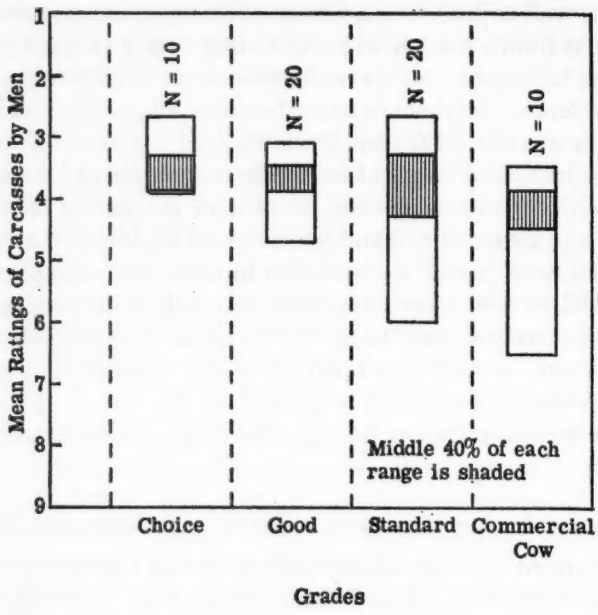

FIG. 3. LOIN RATINGS BY GRADE.

Twenty loins of the 60 each received 75 percent or more of the 24 preferences expressed per pair (Table 4). The popularity of loins as shown by number of preferences was fairly equal by grades for all comparisons except $Good_2$ and Commercial Cow. Only 1 of the 20 Commercial Cow loins received more preferences than the corresponding $Good_2$ loin.

The relatively small differences in general between Choice, Good, and Standard and the larger difference between them and Commercial Cow are shown by both the acceptability and preference data. Since the preference data is more subject to the influence of chance pairings, the mean acceptability data for loins is probably the most useful comparison. In any case the relative inferiority of almost all Commercial Cow loins is evident.

TABLE 3. PREFERENCES* BY GRADE

"Higher"—"Lower" Comparisons	Percent Preferring		
	First Grade	Second Grade	No Preferences
$Good_1$—$Standard_1$	46.2	47.1	6.7
Choice—$Standard_2$	60.4	35.8	3.8
$Good_2$—Commercial Cow	65.0	31.9	3.1

* Includes preferences of all respondents.

Observation of the loin means and the mean of the mean ratings in each shear group leads to the conclusion that shear groupings were at least as functional for classifying carcasses as were the federal grades. Of the loin means with ratings of 4.00 or better, 79 percent were in the shear categories below 18 pounds, while only 19 percent of the loin means rating above 4.00 were in those categories.

TABLE 4. PREFERENCES FOR LOINS BY GRADES

Comparisons:	Gd_1-Std		Ch-Std_2		Gd_2-Co C.		Totals
	Gd_1	Std_1	Ch	Std_2	Gd_2	Co C.	
I. No. of Loins receiving 18 or more of the 24 preferences	3	2	7	1	7	0	20
II. No. of loins receiving more preferences than other loin of pair (Includes I. above)	7	11	11	9	17	1	56
III. No. of loins with preferences evenly divided	2		0		2		4

The simple coefficient of correlation of mean shear value and mean ratings of carcasses was 0.68 (95% confidence limits of 0.51 and 0.79), indicating a definite positive correlation between the two. Thus, the variation in shear values explained about 46 percent of the variation in consumer acceptability ratings.

CHANGING ROLE OF PRICE IN AGRICULTURAL MARKETING[1]

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AGRICULTURAL marketing may be defined in terms of a chain of activities performed to bring farm products to their ultimate consumers. Included are such functions as processing and distribution whereby the raw product is transformed into one desired by consumers and then moved to the point of consumer purchase. The responsibilities for deciding how these are to be performed and for carrying out the tasks involved are divided among many different firms.

One group of firms, for example, processes fruits and vegetables which were grown by another group of firms, and still others provide transportation and wholesale or retail services. Although these businesses are organized as separate enterprises, their input-output functions are technologically interrelated. That is to say, the level of output that can be achieved at one stage of production may depend, for instance, on the quality of a certain input, which was itself determined by the way resources were used at a previous stage. Consider the situation faced by a fruit canner. The type of product he packs and the speed of the processing operation are both affected by certain quality characteristics of the raw product. To the extent that these features are controllable at all, they are so largely at the farm level. After the farmer has made his production plans and then has grown the crop, the canner's ability to control quality is limited.

This paper is concerned with the methods and procedures employed in agricultural marketing to coordinate the decisions made and the resulting actions taken by one firm with those of another. The need for coordinated action perhaps can best be argued in terms of its effect on total resource expenditure in carrying out the *combined* operations of production, processing, and distribution. When the input-output functions of two firms are interrelated, certain of the actions taken by one will affect the selection of actions and consequent income position of the other. Ideally, in order to minimize total resource use for any choice of products, a coordination system must be employed (which in itself is not too costly) that will encourage entrepreneurs at one stage to take into account in their production planning the effects of their actions on the revenue determinants of other members of the system.

The economic gain obtained from the employment of specialized production units can be at least partially dissipated through poor coordination. Considerable emphasis has been placed on increasing efficiency

[1] Giannini Foundation Paper No. 177.

within the firm by internal cost analyses and by plant engineering and layout studies. These represent attempts to organize a number of interrelated operations in such a way that costs of a given output mix will be minimized. On the other hand, less attention has been given to the problem of directing operations that are similarly interrelated but under separate decision-making control.[2] It is evident, for example, that the total costs of fruit production *and* processing may be excessive if the growers do not take into account the effects of raw product quality on the processing operation.

If coordination is to be achieved in a decentralized, specialized marketing system, three conditions should prevail. First, there should be a communication network to link the performance units in the system, such as retail, processing, and farm firms. If one firm's actions are important to another in the sense that they influence the courses open to the other firm, some vehicle must be available to transmit this fact to the interested parties. Second, a language or set of signals should be developed which, when transmitted over the network, accurately characterizes the relevant economic variables. In particular, each firm must be able to judge from this set of signals the relative merits of alternative product offerings which vary in both quantity and quality. One useful appraisal may be indicated by the prices that would be paid for variants in the product's characteristics. And, third, each party must be willing and able to translate the signal received into an appropriate set of actions.

Historically, for many agricultural products, the functions of communication and coordination have been performed within an open market system using prices as the director of economic activity. Prices, serving as the language or set of signals employed, were determined on such markets as the grain exchanges or terminal fruit markets as the result of exchange transactions completed by the representatives of many buyers and sellers. Whatever little personal contact takes place between these parties usually occurs at time of exchange. Each grower makes his adjustment to buyers' requirements after translating the market's evaluation of alternative product offerings, hopefully conveyed by price, into a set of specific production practices.

The advantage in using prices as directors of economic activity is well known. Ideally, data describing a large number of economic variables are summarized in a schedule relating quantity and price with relevant quality factors subsumed under the definition of the product to which the

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[2] The implications for research in agricultural marketing have recently been discussed by R. L. Clodius in his paper "Developing Buying Policies in Decentralized Assembly Markets," *Journal of Farm Economics*, vol. XL, no. 5, December, 1958, pp. 1541-1550.

prices apply. The informational economies obtained have been noted by many writers.[3]

The theoretical arguments for the use of prices determined in an open market system are rather persuasive. Yet, in agricultural marketing, as in many industrial fields, other avenues for coordinating the activities of different firms have been increasingly employed. These procedures may operate in a legal framework in which complete integration based on ownership occurs. But, in agricultural marketing, varying degrees of *incomplete integration* are commonly found. Coordination is effected through a variety of administrative arrangements whereby a number of firms agree to make jointly certain decisions affecting their income positions.

Examples of this looser form of integration can easily be found. Perhaps one of the best known is the relationship connecting feed companies, broiler processors, and farmers. Typically, these firms do not buy and sell from the industry at large on an open market. Rather, they have personalized dealings, restricting their suppliers and customers to a few firms with each of which they have an extensive administrative agreement. This is often given legal status through use of a formal contract. The control of the feed company over many farm production practices indicates the extent to which the decision-making responsibility has been centralized. The processor, too, often participates in these arrangements. He agrees to process broilers supplied by certain growers in exchange for a guarantee from growers and feed dealers of a regular supply of high-quality live birds. Similar instances of incomplete integration are often found between fruit and vegetable canners and the farmers supplying their raw product.

The question suggested by these developments is: Why do firms choose to use such administrative arrangements rather than to rely upon the open market where price provides the main coordinating mechanism? To view these issues more explicity, consider the buyer-seller relationship between vegetable processors and growers.[4] The farmer raises a commodity

[3] F. A. Hayek has summarized the theoretical advantages of employing the price system: "The most significant fact about this system is the economy of knowledge with which it operates, or how little the individual participants need to know in order to be able to take the right action. In abbreviated form, by a kind of symbol, only the most essential information is passed on, and passed on only to those concerned. It is more than a metaphor to describe the price system as a kind of machinery for registering change, or a system of telecommunications which enables individual producers to watch merely the movement of a few pointers, as an engineer might watch the hands of a few dials, in order to adjust their activities to changes of which they may never know more than is reflected in the price movement." "The Use of Knowledge in Society," *American Economic Review*, vol. XXXV, no. 4, September, 1945, pp. 526-527.

[4] Willard F. Mueller, and Norman R. Collins, "Grower-Processor Integration in Fruit and Vegetable Marketing," *Journal of Farm Economics*, vol. XXXIX, no. 5, December, 1957, pp. 1471-1483.

whose characteristics vary not only owing to the operation of chance and natural causes but also in response to the producer's own actions. The grower's choice of production practices can affect such product attributes as variety, size, color, worm and mold count, and time of delivery to the plant. Since his costs vary according to the practices he uses, his income will be affected by the choices he makes.

The effects of these choices are far-reaching, however, since the processor's costs are also influenced by the specific attributes of the raw product purchased from the farmer and, thus, by the decisions made at the farm level. For example, costs of sorting and inspection will be associated with the worm and mold count. Cooking time required will be related to the pH level. Especially important for perishable crops is the rate at which tonnage is delivered to the cannery. When harvesting proceeds too rapidly, the plant becomes glutted and serious losses from spoilage may result.

This example illustrates how one of the parties to a transaction is affected by the actions of the other. It is easily shown, too, that the canner's decisions—for example, how he accepts delivery of the product—influence the grower's welfare. Some such interdependence is present in every buyer-seller relationship. Thus, each firm has an incentive to let the other know how their operations are interrelated. Under what conditions can firms transmit this information when the primary link between them is their common use of prices determined on an open market?

In the simple case mentioned above, there were a number of characteristics of the raw product that were important to both vegetable grower and processor. If prices determined on an open market are to serve as an effective communication and directive device, each party must be able to see in them a representation of the combined production possibilities and preferences of all other decision-makers. The effect on the processor's costs of variants in raw product offerings should be reflected in prices at the farm level. To accomplish this, the price signal obviously must "say something" about *each* of the relevant dimensions that define the raw product. Before the grower can select his optimum production plan, he must be able to judge from market prices the effect of varying each product specification.

Prices available from central or terminal markets are not consistently related to a broad range of their determinants. When such is the case, it is not possible to deduce from reported price relationships exactly what kind of product is desired and then analyze their implications for farm production planning. And, of course, the limitations of such a directive mechanism are much more acute when it is remembered that prices relevant to any transaction are, in fact, not determined until after most of the production decisions have been made.

To effect better coordination, one may ask, why not simply improve

the price mechanism? One must realize, first, that the operation of a price reporting system is itself not free of cost. At the present time, prices are commonly published for broadly defined products. Increased precision would involve a much more detailed classification of prices associated with narrowly defined combinations of product specifications. The expansion of the reporting service to provide detailed prices for a product explicitly defined in terms of only five or ten attributes would multiply the cost many times, if, indeed, it would be possible at all.

It should also be noted that prices are affected by numerous factors that cannot be explicitly included in any market report. Shortage of box cars, fluctuating prices of other commodities, as well as the vagaries of the business world all influence reported prices. Ideally, it is hoped that the producer can sort out the relationships between price and quantity offered and between price and the various quality factors since he is presumably expert in these matters. But the price signal, reflecting, as it does, other broad forces as well, will likely convey the message indistinctly.

Within the range of improvement that can reasonably be expected in market reports, prices will probably continue to be associated with products that are only generally defined with respect to their important characteristics. Thus, at least some data on technical conditions facing industry members will be masked or lost in the reporting process. The resulting inefficiency in resource allocation, compared with that possible under conditions of perfect knowledge, should also be considered a cost of using market price as the major coordinating mechanism.

In agricultural marketing, there has been a trend away from the use of open markets. This has occurred in spite of the constant improvement in our price reporting system. Fuller information on prices has been made available by the wider use of teletype equipment, by the development of electronic grading and sorting devices, and by expanded acceptance of government grading standards. Yet, the increased demand for an improved communication network and for a better coordinating mechanism has seemingly far outdistanced the capabilities of a system based primarily on prices.

Structural changes within the food marketing system have accentuated the sensitivity of firms to the actions of their suppliers and customers.[5] Consider the situation facing large-scale retailers. Their mass merchandis-

[5] George L. Mehren, "The Changing Structure of the Food Market," *Journal of Farm Economics*, vol. 39, no. 2, May, 1957, pp. 339-353. Also, Norman R. Collins, and John A. Jamison, "Mass Merchandising and the Agricultural Producer," *Journal of Marketing*, vol. 22, no. 4, April, 1958, pp. 357-366; and W. W. Cochrane, "Changing Structure of the American Economy: Its Implications for Performance of Agricultural Markets," paper delivered before the joint meeting of the American Farm Economic Association and the American Economics Association, Chicago, December, 1958.

ing approach is designed to move an ever-increasing line of products in large volume. Volume movement requires a stable supply to guard against out-of-stock conditions. Product uniformity, too, is important in building consumer loyalty. If supply becomes erratic, the repercussions may be severe for a typical supermarket which is keenly adjusted to a particular type of merchandise. The whole operation of the retail store is routinized with reference to a narrowly defined set of characteristics of the products handled. The essentially unoriented production which has resulted from producers' individual responses to open market prices often does not prove satisfactory in meeting the product needs of large-scale retailers. Terminal markets for fruits and vegetables were developed as collection depots for individual shipments from widely scattered loading points. It is virtually impossible to convert such heterogeneous supplies into a stable flow of uniform products.

An alternative is for retailers to participate directly in the decision-making process of their suppliers. Instead of translating the technical conditions facing the retail operation into a price message which is then relayed to and interpreted by supplier firms, conversations are held directly in terms of actions to be taken or in terms of the desired product specifications. The intermediate step, with its chances for error, is avoided. The larger retail grocery firms have, in fact, taken advantage of this technique. They tend more and more to buy directly from growers or a co-operative marketing agency, by-passing auctions, consignment markets, and wholesale commission merchants.

Production decisions often must be made well before the exchange transaction is completed and prices reported. This is particularly true of the farmer's production plans, where the intervening period may be as long as several years. Partial information on which to base such decisions can be derived from past price relationships. But, through direct negotiation among the firms later to be parties to an exchange transaction, the actions of each may be directly stipulated and uncertainty to each party concerning the other's performance reduced. For example, a canner may have to estimate the condition of future crop prospects in order to sign delivery commitments with large chain stores. One course would be to judge future prospects on the basis of past grower performance. But the grower may be deciding on some of these matters at the same time the canner is making his evaluation. By negotiated dealings with growers within a framework that permits these producer decisions to be made jointly, the canner not only gains information on what these decisions are but also may exert some control over their selection.

Of course, such arrangements for joint decision-making also incur a cost. In any particular case, the costs associated with the operation of an open market system, which include the inefficiencies resulting from im-

perfect knowledge, should be compared with those associated with the use of an administrative arrangement within which the variables of mutual importance are determined through negotiation. The interest in efficiency arises out of a desire to increase total returns to industry members. Implicit in this argument is the assumption that not only is it *possible* thereby to improve the income situation of every party but that this is *actually* done. Becoming involved in a joint decision-making procedure may be resisted by certain groups because of their fears concerning the associated effects on income distribution.

Through such negotiations firms deal directly with each other in determining a comprehensive set of actions to be taken by each party and a set of product specifications mutually agreeable. Prices determined on an open market are not relied upon to transmit information concerning the detailed requirements of each participant. Yet, price determination is of crucial importance in these dealings, being basic to the allocation of income between the parties and allocation of resources among alternative uses. Within these interfirm relationships, however, price can be viewed as a variable which is established simultaneously with, or perhaps even after, the making of decisions concerning the performance expected of each firm.

THE DETERMINATION OF GRAZING FEES ON FEDERALLY-OWNED RANGE LANDS[1]

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The Federal Range

IN HIS message to Congress in 1877 newly-elected President Hayes said,

> These lands [west of the hundredth meridian] are practically unsaleable under existing laws, and the suggestion is worthy of consideration that a system of leasehold tenure would make them a source of profit to the United States, while at the same time legalizing the business of cattle raising which is at present carried on upon them.[2]

President Hayes' suggestion was not acted upon by that, or ensuing, congresses until 1934 when a system for the supervision of Federal range lands was approved by Congress in the Taylor Grazing Act. In the intervening years much of this land was transferred to private ownership through homestead acts, grants to railroads and various other disposal methods. The government still retained however, a vast residue of left-over lands in the deserts and high plateaus of the arid West. This land was generally too dry, rough or rocky for crop production and had commercial value mainly as pasturage. Over much of the territory west of the one hundredth meridian land itself was worthless unless that land contained a creek, spring, or other source of water. Competition for water and the scant grass and browse of this free land was chiefly responsible for the range wars and the "romantic" legend of the guntoting cowboy.

Stockmen attempted to reserve grazing rights for themselves by homesteading waterholes, by acquiring land along creeks, by checkerboard patterns of ownership, and by various other devices. Public lands reserved by the acquisition of these "key" tracts had, of course, little value for other potential users. Conversely, the "key" tract ordinarily had limited value in itself unless it was supplemented by free government land.

In spite of the many ingenious methods used to reserve Federal land for private use, there was considerable land which never became stabilized into this reserved status. This land belonged to everyone and to no one. It was "free land."

There were two general results of this "free land" situation. First,

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[1] Excerpts from this article will appear in a case study, *The McCarran Purge*, to be published by the Inter-University Case Program, 45 East 65th Street, New York 21, New York.

[2] James D. Richardson, *Messages and Papers of the Presidents*, Vol. IX (New York: Bureau of National Literature Inc.), p. 4428.

squabbles among stockmen over range and water continued interminably and even the most powerful operators lived an uncertain economic existence. Secondly, the "free range" *had* to result in overgrazing because each stockman knew that if he did not completely utilize the forage—someone else would. Overgrazing encouraged erosion by removing plant cover. Lands which once produced vigorous stands of native grasses became, and remain today, virtual deserts.

After half a century of range wars and a rapidly deteriorating public range the stockmen came to the realization that some regulation of the public lands was necessary. After several unsuccessful attempts at Federal legislation, the Taylor Grazing Act of 1934 was adopted.

The general objectives of the Taylor Grazing Act were: "To stop injury to the public grazing lands by preventing overgrazing . . . to provide for their orderly use . . . to stabilize the livestock industry dependent upon the public range. . . ."[3]

To accomplish these purposes, the Secretary of Interior was authorized to establish grazing districts and to issue grazing permits, not to exceed the carrying capacity of the range, to qualified persons on payment of a reasonable fee for specified seasons of use.[4]

The First Grazing Fee

When the Taylor Grazing Act was under consideration by the House Committee on Public Lands in 1933 Secretary Ickes was asked: "Is it contemplated that the government will derive revenue from this measure?" Ickes replied: "Yes; just the expense of operation. We are not trying to make money out of it."[5] The following year Ickes reiterated his position that "We have no intention of making this a revenue producer at all. We would like for the range to pay for its own administration but nothing more."[6]

Possibly these statements were designed to encourage passage of the bill but, whatever the motive, western stockmen came to understand that grazing fees were to be fixed according to the cost of administering the program—and that the cost of administration would be negligible.

Shortly after the passage of the Act 142 million acres of Federal range land plus several million acres of state, county and private holdings were

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[3] *The Taylor Grazing Act of June 28, 1934* (Washington: U. S. Government Printing Office, 1955), p. 1.

[4] In effect, the Act substituted administrative discretion for competition in determining how the land was to be used, at what price, and by whom. Administrative discretion, however, does mean administrative fiat as will become evident in this chronology.

[5] U. S. Congress, House, Committee on Public Lands, *Hearings, 73d Cong., 1st Sess. (1933), on H. R. 2835*, p. 16.

[6] U. S. Congress, Senate, Committee on Public Lands and Surveys, *Hearings, 73d Cong., 2d Sess. (1934), on H. R. 6462*, p. 7.

organized into grazing districts to be administered by a newly-created Division of Grazing in the Department of Interior. These grazing districts were scattered throughout all the western states except Washington. In this tremendous area there existed wide diversities in topography, climate, soils and vegetation. Probably the only significant uniformity was that almost all the grazing districts were located in areas of less than 15 inches of annual rainfall.

Once the grazing districts were established, F. R. Carpenter, the first Director of the Division of Grazing, attempted, almost simultaneously, to formulate regulations on range administration, to gather as much information as possible on the districts to be administered, and at the same time, put the program into effect. This was a most ambitious undertaking. According to Carpenter, "Advisory boards looked like the answer." Such boards could provide much of the information necessary and at the same time assist in the decision-making process both on detail matters and major policy items. The use of these boards would also help secure local compliance and support.

The first regulation published by the infant Grazing Division provided for the election of an advisory board from the permittees in each grazing district. According to Carpenter, these advisory boards were to be "the local governing agency as to all matters of a range regulatory nature."[7]

No grazing fees were levied in 1935 nor did the Secretary of the Interior attempt to establish "reasonable fees" for grazing privileges at that time. Instead, the advisory board members were called together in a mass meeting in Salt Lake City on January 13-14, 1936 to decide upon a set of regulations to govern the new agency. Among other matters, the advisers agreed upon a uniform grazing fee of 5¢ per Animal Unit Month (five cents per month for a cow or horse and one cent per month for a sheep or goat). The Secretary accepted this recommendation and the 5¢ A.U.M. (animal unit month) fee became effective during the 1936 grazing season. At this rate the cost of grazing a cow for seven months (an average grazing season) would be 35¢.

Nevada stockmen objected even to this low fee and obtained an injunction from a Nevada district court "restraining the Regional Grazier from interfering with their free use of the range."[8] Nevada stockmen, as well as some ranchers in other states, had built their livestock operations on the assumption that they would continue to enjoy free use of the Federal range. The range was not usually an extra, or bonus, piece pasture; it was more likely to be an integral part of the ranching unit. Access to the range

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[7] U. S. Department of Interior, *Annual Report of the Secretary,* (Washington: U. S. Government Printing Office, 1935), p. 116.

[8] *Annual Report of the Secretary,* 1939, p. xi.

ordinarily increased the value of ranch properties so a ranch buyer actually paid for both the private and public lands in the unit. Ranchers also maintained that, since property values (and hence assessed values) were based on capitalized income, they had in actuality been paying property taxes on Federally-owned lands. Objecting stockmen also contended that a uniform fee for all parts of the range was unfair because of the great variations in value of the forage.

The action of the District Court was appealed to the Nevada Supreme Court which sustained the action of the lower court and held that grazing fees for temporary licenses was unauthorized in the Taylor Grazing Act and that a uniform fee for all districts and all users did not conform to section 3 of the Act which provides for "the payment annually of reasonable fees *in each case*. . . .55[9]

The case was appealed to the United States Supreme Court which reversed the decision of the Nevada Court on May 26, 1941. Mr. Justice Roberts, in delivering the opinion of the Court, held that "repeated appropriations of the proceeds of the fees . . . not only confirms the departmental construction of the statute but constitutes a ratification of the action of the Secretary as the agent of Congress in the administration of the act."[10]

One of the most effective advocates of the interests of Nevada stockmen was Senator Pat McCarran. While the *Dewar v. Brooks* case was awaiting consideration by the U. S. Supreme Court, Senator McCarran rallied to the support of his constituents by introducing Senate Resolution 241. This resolution demanded an investigation of the Grazing Service to determine the extent to which administrators had exceeded their authority and had generally functioned in a manner detrimental to western stockmen.[11] The resolution was adopted in May, 1941 and Senator McCarran embarked on an investigation which lasted until the fall of 1947.[12]

The Saunderson-Leech Range Appraisal Study

While the Grazing Service was awaiting the Supreme Court's decision on the legality of the uniform grazing fee it instituted a study of grazing fees on the basis of range appraisals of average forage values in each of the range states. A further objective of the study was to determine the practicality of fixing "reasonable fees in each case." J. H. Leech of the

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[9] *Dewar v. Brooks*, 60 Nev. 219; 106 P. 2d 755.

[10] *Dewar v. Brooks*, 313 U. S. 354.

[11] U. S. Congress, *Congressional Record*, 76th Congress, 3rd Sess. (1940-41), Vol. 86, 2593.

[12] Senate Res. 241, 76th Cong., extended by Senate Res. 147, 77th Cong., S. Res. 39, 78th Cong., and S. Res. 139, 79th Cong.

Grazing Service and Mont Saunderson of the Forest Service conducted the survey. The results of this study are summarized below:

RANGE APPRAISAL[13]

States	*Base Value For Grazing Fees Per A.U.M.*
Utah	12.0¢
California	13.8
Nevada	12.4
Oregon	14.0
Idaho	16.7
Montana	16.7
New Mexico	07.3
Colorado	18.5
Arizona	08.4
Wyoming	15.8

It was also recommended that the fee be varied from year to year in accordance with changes in the price of beef and mutton.

By the time the Saunderson-Leech study was completed in June, 1941, the Supreme Court had upheld the legality of the old uniform 5¢ fee so there was at least no legal compulsion to change the rate from state to state or "in each case" as claimed by the Nevada Supreme Court.

The Saunderson-Leech Range Appraisal was considered by McCarran's Investigating Subcommittee on Public Lands in hearings at various points in the West during the fall of 1941. According to Senator McCarran,

> The findings of the Range Appraisal Study were subjected to critical analysis by the livestock men in several hearings before my subcommittee in 1941. These analyses disclosed that the results of the study furnished little or no support to the recommendation for increasing the fees.[14]

No immediate action was taken by the administration to implement the findings of the Saunderson-Leech Range Appraisal. Instead, the study was submitted to the various state advisory boards for their comments. By this time, the advisory board system had been expanded to include state advisory boards and a National Advisory Board Council (NABC).

The State boards, without exception, voted against any increase in fees.[15] The Range Appraisal study was next presented to the NABC on January 5, 1942. By this time we had entered World War II. Following

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[13] Bureau of Land Management, "A Comparison of Grazing Fees on National Forests and Grazing Districts." Unpublished paper prepared for National Advisory Board Council Meeting, September 6, 1950.

[14] Senator Pat McCarran, "A Report on Public Land Grazing Fees," *American Cattle Producer*, June 1946, p. 8.

[15] Bureau of Land Management, "A Comparison of Grazing Fees on National Forests and Grazing Districts." Unpublished paper prepared for NABC Meeting, September 6, 1950.

the lead of the state advisory boards, the NABC passed a resolution which stated in part:

(2) We advise and recommend against the applications of the findings in Range Appraisal as to a "reasonable fee" until the present emergency is past.

(3) . . . we pledge ourselves to sit down with the Grazing Service when the present emergency is past and give our full assistance in determining and applying a reasonable fee. . . .[16]

Grazing Service Director R. H. Rutledge accepted the NABC's recommendation, as did Secretary Ickes. In a letter to Senator Hatch of New Mexico (member of the Senate Committee on Public Lands & Surveys) dated April 2, 1942, Ickes wrote, "In view of the war situation, I believe that the fees for grazing upon the Federeal range should not be disturbed for the present . . . however, I think that meanwhile the entire fee question should receive serious and comprehensive consideration."[17]

During the next two years meat prices continued to rise and demands for increased grazing fees also continued. Members of the House Subcommittee on Interior Appropriations were especially insistent that fees be raised. Congressman Jed Johnson, Democrat from Oklahoma and Chairman of the Subcommittee, was especially critical of Grazing Service appropriation requests as long as the 5¢ fee prevailed.

The Forsling Proposal

In November 1944, Clarence L. Forsling, newly-appointed Director of the Grazing Service, revived the fee question at a meeting of the NABC. He proposed a trebled fee schedule which was to be based on the value of the forage in any subsequent adjustments. Forsling's proposal met with unanimous opposition from the assembled members of the twenty-man National Advisory Board Council. They maintained that the proposed increase in fees would violate an assurance made to the livestockmen by Secretary Ickes that he "had no intention of making the Act a revenue producer at all" and that the proposal repudiated promises from the Department of the Interior that the fees would not be raised for the duration of the war. The board members formally resolved that:

This organization opposes such increase for the following reason:

1. Any fee finally fixed must be based on a direct relation to the reasonable cost of administering public lands for grazing purposes only and nothing more. Until the fact as to the cost of administration, together with the necessity therefor and their relation to grazing, are determined, no one can fix a reasonable fee as provided by the Act.

When Senator McCarran heard of Forsling's proposal he introduced a

[16] Minutes, National Advisory Board Council Meeting, January 5, 1942.
[17] Letter of April 2, 1942, Secretary Ickes to Senator Hatch of New Mexico.

resolution, adopted unanimously by the Senate Committee on Public Lands and Surveys, ". . . that no increase in grazing fees should be imposed until the Committee . . . has had an opportunity to make a full and complete study of the subject."[18]

Senator McCarran elicited a promise from Secretary Ickes that fees would not be changed until his committee had made an investigation.

Again Senator McCarran's committee conducted a series of hearings throughout the western states on the question of increased fees. Friends of the Grazing Service maintained that Senator McCarran used these hearings primarily as a stage from which to blast the Grazing Service in general and the proposed fee increase in particular.

When Director Forsling met the Appropriations Subcommittee, in March, 1945, he testified that he believed increased grazing fees were necessary and desirable; that he recommended such an increase; and that increased fees had not yet been made effective because the Secretary of Interior had promised to withhold action until the matter had been studied by McCarran's Committee on Public Lands and Surveys. He stated further that he expected a report from that committee by July of that year (1945). The committee was naturally favorably impressed by Forsling's views but Representative Norrell of Arkansas reiterated the Committee's stand on fees when he said:

> . . . I do not see any reason why the people in some other states should be called on year after year to provide an increased contribution to the livestock growers of the West. . . .[19]

While the Appropriations Subcommittee may have been pleased with Forsling's testimony, Senator McCarran considered it a treacherous attack on the stockmen. According to him:

> The larger fees were and are sought by the Grazing Service for one purpose; and that is that the increased collections may serve as a justification for still larger appropriations and further expansion of the organization.[20]

The report of the McCarran Committee, which Director Forsling had expected would be completed by July 1945, was not submitted until the spring of 1946. The report found that no increase in fees was justified, that fees should be based on the cost of administration rather than on the value of the forage, and that the cost of administration was too high. In addition, McCarran charged the Grazing Service with unnecessary

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[18] U. S. Congress, *Congressional Record*, 78th Cong., 2d Sess., Vol. 90 (1944), pp. 9558-59.

[19] U. S. Congress, House, Hearings before a Subcommittee of the Committee on Appropriations, 79th Cong., 1st Sess., *The Interior Department Appropriations Bill for 1946*, p. 463.

[20] Senator Pat McCarran, "A Report on Public Land Grazing Fees," *American Cattle Producer*, June 1946, p. 15.

bureaucratic expansion and urged the dismissal of a "very small handful of self seeking opportunist administrators."

By this time Secretary Ickes had apparently given up. In a letter to Senator Hatch, he wrote: "I have decided to take no action to increase the grazing fees on the Federal range until 6 months after the discontinuance of payments for beef-cattle production and for sheep and lamb production. . . ."[21]

When Director Forsling next appeared before the House Subcommittee on Interior Appropriations in March 1946, the Committee's attitude toward him had drastically changed since his appearance the year before. Chairman Jed Johnson thought it was "just shocking that the Grazing Service will continue to charge practically nothing. One cent per month for sheep . . . Can you imagine that!"[22] It seemed to Johnson that "the Grazing Service is to all intents and purposes, thumbing its nose at this committee."[23] Johnson seemed to hold Director Forsling personally responsible for the continuance of the five cent fee, and like Senator McCarran, but for opposite reasons, he apparently felt that Forsling had betrayed a trust.

". . . I would appreciate your testimony much more," scolded Representative Norrell, "if you would just come before us and tell us that the reason why these fees have not been increased is because the western Senators and Congressmen objected, because that is exactly the situation, and you know it, and I know it."[24]

Mr. Norell continued: ". . . I think we are going to have to cut the appropriation of this Department down to the amount it has paid into the Federal Treasury . . . before we ever get an increase in fees."[25]

This language could have been interpreted as an attack on Senator McCarran and some of his supporters—as well as on the Grazing Service. But McCarran agreed, "The only way, in my judgment," he said, "to get the Taylor Grazing Act back again to a solid foundation is not to increase this appropriation now, but to hold . . . [it] down where the House put it, until the Interior Department sees fit to set up a Taylor Grazing Administration that will be worthy of the name and the object of the law."[26]

In the meantime the stockmen's associations and the advisory boards had not been idle. A task force called "The Joint Livestock Committee on

[21] Letter of January 25, 1946. Secretary Ickes to Senator Carl A. Hatch.

[22] U. S. Congress, House, Hearings before the Subcommittee of the Committee on Appropriations, 79th Cong., 2d Sess., *The Interior Department Appropriations Bill for 1946*, p. 147.

[23] U. S. Congress, House, Hearings before the Subcommittee of the Committee on Appropriations, 79th Cong., 2d Sess., *The Interior Department Appropriations Bill for 1946*, p. 148.

[24] *Ibid.*, p. 174.

[25] *Ibid.*, p. 177.

[26] *Ibid.*, pp. 1252-1254.

Public Lands" was organized to oppose the proposed increase in grazing fees. This organization represented the National Woolgrowers Association, the American National Livestock Association (now the American National Cattlemen's Association) and the NABC. The Joint Livestock Committee on Public Lands not only resisted increased grazing fees but it also approved the proposed drastic cuts in appropriations for the Grazing Service.

On May 8, 1946 Representative Jed Johnson attacked the Grazing Service on the floor of the House:

> It [the Taylor Grazing Act] passed . . . after a certain former Secretary of Interior appeared before . . . Congress and assured us that . . . it would be self-supporting. Over and over we were told that the Grazing Service would be self-supporting.
>
> ....
>
> But what did the Grazing Service do? They went out and practically turned it over to the big cowmen and the big sheepmen of the West. Why they even put them on the payroll . . . it is common knowledge that they [the big stockmen] have been practically running the Grazing Service.
>
> . . . we gave them $425,000, the amount they collected . . . and we said to the Grazing Service: "Live up to your contract; live within your revenue" and by the eternals they are going to do it whether they like it or not."[27]

The following day, May 9, 1946, Senator McCarran blasted the Grazing Service in the Senate. He accused the Grazing Service of misinforming the Appropriations Subcommittee and of driving for unwarranted increased grazing fees for the sole purpose of using the increased revenues as a basis for additional appropriations by which a very few grasping individuals could satisfy their lust for power by building a bigger empire.[28]

Director Forsling and the Grazing Service were caught in a triple play between a Senate Committee which refused to allow increased fees, a House Committee which cut appropriations because fees were not raised, and a powerful interest group which supported both committees. The result was inevitable.

The Grazing Service appropriation for salaries and expenses was cut to $550,000 of which $125,000 was earmarked for terminal leave pay.[29]

Director Forsling was relieved of his duties with the Grazing Service and was reassigned to the Southwest Field Committee of the Department of Interior.

On July 16, 1946 the Grazing Service was reorganized into the Bureau of Land Management and ceased to exist as a separate organization.

Grazing fees remained at 5¢ per A.U.M.

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[27] U. S. Congress, *Congressional Record*, 79th Cong., 2d Sess., Vol. 92 (May 8, 1946), p. 4634.

[28] *Ibid.*, pp. 4690-4694.

[29] The appropriation for fiscal year 1946 was $979,470.

The Nicholson Plan

The Bureau of Land Management was formed by the amalgamation of the Grazing Service and the old General Land Office. By this time Harold Ickes had been replaced by J. A. Krug as Secretary of Interior.

Reduction in appropriations and reorganization of the grazing activity into the Bureau of Land Management did not solve the problem of grazing fees. In an attempt to find his way out of the grazing fee dilemma, Secretary Krug appointed Rex Nicholson, a California cattleman, to make a study of grazing fees, organization and personnel of the Federal grazing activity.[30]

One of Nicholson's first moves was to meet with the American National Live Stock Association and the National Woolgrower's Association at Salt Lake City on September 16-17, 1946. Nicholson was introduced to the stockmen by Senator McCarran who declared: "He is going to reorganize the Grazing Service, and if he gets a free hand you will benefit 100 percent."[31]

At the same meeting Nicholson met with the National Advisory Board Council and received their recommendations.[32] He also sent out a questionnaire to district advisory board members. The resultant "Nicholson Plan" sidestepped any consideration of fees based on the value of the forage. It assumed that grazing fees should only cover the cost of administering the program. That much was "given." The problem then became one of determining how extensive the program should be and what part of the cost of that program accrued to the direct benefit of the stockmen who used the Federal range. The primary problem, by using this approach, was no longer a question of grazing fees—it now became a problem of how extensive the administration should be and what portion of that administration directly benefited the users of the range.

The stockmen apparently wanted to continue Federal regulation of the range but at a minimum level of activity. To satisfy these objectives Nicholson proposed an organization not to exceed 242 persons.

The Secretary of Interior then obtained an estimate from the Bureau of Agricultural Economics to the effect that only 70 percent of the costs of range administration accrued to the benefit of the users of the range while the other 30 percent benefited the public generally.

From this point on it became simply a matter of calculating 70 percent of the cost of employing 242 persons plus other costs incident to the program. This was the figure which was then to be raised by grazing fees.

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[30] *Annual Report of the Secretary of Interior 1947, op. cit.*, p. 284.
[31] *American Cattle Producer*, September 1946, p. 13.
[32] *Ibid.*

On the basis of past use records, Nicholson calculated this fee should be about 8 cents per A.U.M.

The acceptance of the Nicholson formula had generally undesirable effects for the administration of the Federal range. It acted as a double-edged sword both to prevent the establishment of a realistic grazing fee and to restrict the regulatory and rehabilitation efforts of the administration. If grazing fees were to be determined by the cost of administration, and if the cost of administration was kept low—obviously there would be no point in raising the fees. On the other hand, conservation and rehabilitation activities could not be expanded because to do so would be to exceed the amount collected in fees.

The Advisory Boards and the stockmen's organizations were heavily committed to the Nicholson Plan. By 1950, however, it became obvious that Nicholson's formula had serious deficiencies aside from its "cost of administration" basis. Nicholson had recommended a static fee—but costs of performing the same functions did not remain static; they increased. The Nicholson cost structure was obsolete the day it went into effect. The plan was a failure, not only because it was based on an unsound and unworkable concept, but also because of its rigidities in both revenues and expenditures.

By 1950 BLM officials felt they could sell the stockmen on another increase in fees—if for no other reason than that the prevailing fees failed to provide enough revenue to satisfy even the minimum requirements of the Nicholson Plan. In effect, they could say to the stockmen, "you agreed to provide us with funds enough to maintain a certain standard of operation -now we are asking you to live up to the terms of your agreement."

Bureau of Land Management officials also reminded the stockmen that the current 8¢ fee was considerably below the average fees charged by the Forest Service. The following table sets forth this comparison for the years 1936-1950.

Bureau of Land Management director, Marion Clawson, presented these complaints to the NABC on September 6, 1950. The NABC responded with the following resolution:

WHEREAS, According to the Nicholson plan and report, the number of personnel to adequately supervise and administer grazing under the Taylor Grazing Act was: department 8; regions 43; and districts, 191; for a total personnel of 242, and

WHEREAS, Since such report, the cost has gone up, and

WHEREAS, We deem it necessary to adhere to the Nicholson plan as to personnel,

Now Therefore, We recommend to the Director of the Bureau of Land Management that if an increase in fees is necessary to take care of said personnel,

A COMPARISON OF GRAZING FEES ON NATIONAL FORESTS AND GRAZING DISTRICTS[33]

National Forest Grazing Fees			*Grazing District Fees*	
Dates	*Cattle*	*Sheep*	*Cattle*	*Sheep*
1936	13.05	3.36	5	1
1937	12.55	3.66	5	1
1938	14.98	4.24	5	1
1939	13.4	3.3	5	1
1940	14.89	3.69	5	1
1941	15.97	3.85	5	1
1942	18.9	4.6	5	1
1943	23.0	5.5	5	1
1944	26.0	6.25	5	1
1945	24.8	6.03	5	1
1946	27.0	6.25	5	1
1947	31.0	7.5	8	1.6
1948	40.0	10.0	8	1.6
1949	49.0	11.0	8	1.6
1950	42.0	10.75	8	1.6

then such fee be put into effect; and in no case is said fee to exceed 12¢, of which 2¢ shall be for improvements.[34]

Abandonment of the Cost of Administration Concept

The increase in fees to 12¢ per A.U.M. obviously did not correct the inequities and the impracticality of the Nicholson plan. Director Clawson, therefore, instituted another grazing fee study in 1952. Clawson's study followed somewhat the same pattern as Mont Saunderson's study eleven years earlier except that it was much more extensive and was conducted by selected BLM personnel who devoted their full time to the study. The survey included 487 samples of private lands totalling 3,634,000 acres and samples of Federal range totalling 7,500,000 acres. The purpose of the survey was to determine the value of the forage in the different areas according to average livestock prices received by the growers during the five year period 1947 to 1951. The rates recommended in this study ranged from 20¢ per A.U.M. to 40¢ per A.U.M. for an average of 28¢.

By the time the report was completed Clawson was on his way out as Director and the NABC was none too cooperative. At the meeting of February 16-19, 1953 the NABC passed resolutions recommending that the stockmen decide the season of use and the carrying capacity of the range and vetoed any increase in grazing fees.[35]

In his meeting with the NABC in February 1954 the new Director, Edward Woozley, resurrected the 1952 study and again broached the subject of a revised grazing fee. By this time the NABC seemed receptive

[33] Bureau of Land Management, "A Comparison of Grazing Fees on National Forests and Grazing Districts," (Unpublished paper), 1950.

[34] Minutes, National Advisory Board Council Meeting, September 6, 1950.

[35] Minutes, National Advisory Board Council Meeting, February 16-19, 1953.

to a suggestion that the cost of administration basis for fees be abandoned and that a fee based on livestock prices be substituted therefor. The matter was given further study during the summer and was presented again at a special meeting of the NABC on August 2-3, 1954. At this meeting the NABC agreed to a fee system based on the combined prices of cattle and sheep in the markets of the 11 western states. Thus if cattle prices average 17¢ per pound and sheep 15¢ per pound during a given year, the average of the two, or 16¢ in this case, would be the grazing fee per A.U.M. during the following year.

According to this formula, the fee for 1955, based on market prices in 1954, would have been about 18¢ per A.U.M.—or 6¢ higher than the prevailing 12¢ rate. Director Woozley considered this 50 percent raise to be "too much of an increase at one time under present conditions" and suggested that he would seek Departmental approval of an increase to 15¢ per A.U.M. for 1955 and 1956 with the understanding that the fee in 1957 would be adjusted to the combined average per pound price of cattle and sheep in 1956.[36]

The National Advisory Board Council accepted Director Woozley's proposal which was then referred to the various state advisory boards. The plan was endorsed by the boards of all the range states except Nevada.

We have noted that the new fee system was to have become effective on January 1, 1955 but that a compromise fee of 15¢ per A.U.M. was adopted instead—with the understanding that the new formula would become effective in 1957. However, application of the new fee formula was again postponed, this time to 1958, because of severe drouth conditions during 1956. Grazing fees therefore remained at 15¢ per A.U.M. during 1955, 1956 and 1957.

On November 21, 1957, the Secretary of Interior issued Circular No. 1988 amending the Federal Range Code in accordance with the new grazing formula. The grazing fee for 1958, based on average livestock prices during 1957, was set at 19¢ per A.U.M.[37]

After two decades of uncertainty and bitter dispute it appears that a politically acceptable formula for determining grazing fees has been established. While this formula has no direct relation to the value of the forage it does have some economic justification in that fees now vary according to average market prices. Most important, however, is the abandonment of the "cost of administration" concept which, for so many years, prevented any realistic approach to grazing fees and which acted to frustrate attempts at range conservation and rehabilitation.

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[36] Kerr, G. M. "A Basis for Determining Grazing Fees in Grazing Districts" (Unpublished paper written in November 1954).

[37] Federal Register, January 28, 1958, p. 546.

THE CORNELL SYSTEM OF ECONOMIC LAND CLASSIFICATION[1]

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A SYSTEMATIC method of economic land classification has now been in use at Cornell University for twenty-five years. It rested originally upon purely practical generalizations drawn from farm management research experience. It had been found that farm incomes were low in certain areas and that these low income levels persisted over extended periods of time. It had been found, moreover, that the land in most low income areas had both morphological and performance characteristics different from land in high income areas, and it was presumed that this difference explained the income differences. Inasmuch as the interest in farm income differences was general among both farmers and others connected with agriculture, it was concluded that the making of income-area maps not only would be possible but would be useful as well.

The methods actually put into use in the classification work involved a further assumption, one that was partially tested in both the first and subsequent studies. It was assumed that farm income levels could be judged by experienced men familiar with farming in an area, and familiar with general farm management findings, on the basis of rather inexpensively observable indicators, without the cost of detailed and repeated farm management surveys.

In the first classification study, farms were placed individually into four categorical income classes: those with income expectancies too low to continue to attract farm operators; those with expectancies only sufficient to attract operators; and two classes with successively higher income levels above this. No specific class limits were established in dollars. The higher classes were defined formally only as having higher income expectancies. Each class was, however, associated in the minds of the workers with certain levels of living. The second class included farms where operators could afford only minimal housing, seldom could accumulate a reserve for retirement, usually could maintain their farm capital only at levels barely necessary for continued operation. The higher classes were described in terms of frequencies with which operators could retire with adequate savings, could send children to college, and the like.

The categorical classes were converted into cartographic classes for final presentation on maps. Formal specifications were laid down for the

[1] This paper was presented at the Seminar on the Economic Aspects of Land Use held at the Ontario Agricultural College, Guelph, Ontario, September 11-13, 1957.

sizes of the smallest areas to be shown on the final map—not less than three farms. Informal and unrecorded specifications were laid down for the maximum permissible awkwardness of the final areas. The cartographic classes of farms were counterparts of the corresponding categorical classes and approximated the latter as nearly as the minimum-area and maximum-awkwardness specifications would permit. Two cartographic classes were introduced, however, without categorical counterparts in the farm classification scheme. One of these was used to identify more or less concentrated residential settlement with too few farms to justify a farm classification. The other was used to identify sparsely settled areas without farms. Many of the latter areas had once contained operating farms, but since had been "abandoned."

A fifth categorical class was introduced in later studies, with its cartographic counterpart, to identify an income level higher than any that occurred in the county studied first. (A sixth class was used for a short time to identify developed muck-land areas, but this class was an anomaly in the system because of its unique criterion, so was dropped.)

The maps that were produced by this method created immediate and widespread interest. Those were depression days, and farmers, bankers, merchants, and everyone else connected with agriculture was in trouble, particularly in some areas of the state. The classification was simple—only six classes—and the differences pictured on the maps could be pointed out in the field to anyone acquainted with farming. The maps, in fact, served only to crystallize differences leading farmers and many agricultural specialists already had vaguely in mind.

The demand for extension of the method to other areas was great. The method therefore was standardized on the patterns used in the first study and extended to about twenty counties in that form. This made it possible to cover a large area quickly, but it later brought trouble, especially in areas where types of farming, land conditions, and historical patterns of agricultural development differed widely from those in the area where the methods were originally formulated. It is fortunate that World War II came in time to forestall the publication of three maps nearing completion at that time. Two maps previously had been published that proved later to be below standard and a third published map was soon to be seriously criticized in areas where abandoned dairy farms were being converted to at least temporarily successful potato farms.

World War II provided an occasion for reflection and a re-examination of methods. This re-examination was a fairly complete one.

The practical usefulness of most of the maps that had been made was clear enough. People not only said they were valuable, but used them. Subsequent observations and statistical evidence confirmed the predic-

tions implicit in the maps. Most of the work passed all pragmatic tests with flying colors. And this in spite of the fact that the method had an almost exclusively empirical grounding; in spite of the fact, indeed, that the possibility of making such maps was denied by all traditional theories of rent, land values, and incomes recorded in textbooks for over a hundred years. At the same time, the fact could not be avoided that the system was running into trouble. Why had it worked so well up to a point? Why had it worked so well to this point in spite of the denials of traditional theory? Could it be changed so it would work beyond this point?

Many more questions were raised. In fact, questions were raised and answered that make it now possible to write of the original system as I have described it above. It was not described this way by those who wrote about it at the time.[2] "Intensity of use to which the land is adapted," rather than income, was presented as the criterion. Land rather than farms, was spoken of as the object being classified. The connection between physical land variability, either morphological or performance variability, and farm incomes had not been explicitly developed. The relationships between the criterion of the system and factors being used only as indicators of criterion values had not been spelled out. The distinction between categorical and cartographic classes was not recognized. And statistical analyses of inter-class differences were limited largely to computation of arithmetic averages without examinations of frequency distributions.

The re-examination brought a clear understanding of the pioneering contribution of those who originated the system. They had built a device that was useful and one that was potentially even more useful. And their approach was one that could not have come out of minds steeped in traditional theory. But it needed development and a more complete logical foundation.

The systematic re-examination of methods was started as soon as transportation and man-power became available after the War. Two studies were completed under the direction of F. F. Hill before 1950.[3] Subsequent work on methods has been combined with the production program.

The methods work led early to the conclusion that most users of the

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[2] A. B. Lewis, *Methods Used in an Economic Study of Land Utilization,* Cornell University Agricultural Experiment Station Memoir 160, 1934.

Alexander Joss, *Handbook of Directions for Land Classification in New York State,* Cornell University, Department of Agricultural Economics, A.E. 324, 1940.

[3] C. V. Plath, *An Analysis of Economic Land Classification in Northern Livingston County, New York, and a Proposed Method for Future Classification,* Cornell University, unpublished Ph.D. thesis, 1947.

H. E. Conklin and S. O. Berg, *A Preliminary Report on Developments in Land Classification Methods,* Cornell University, Department of Agricultural Economics, A.E. 688, 1948.

classification maps are more interested in incomes than in intensity or any other characteristics of farms or land. This at least seemed to be true in New York where kinds of farming are fairly stable and reasonably well adjusted to the land; where good soil maps, climatic data and other descriptions of the physical characteristics of the land are generally available; and where farm incomes vary widely within short distances. It was decided, therefore, to use incomes as the criterion of the system. This decision led in turn to the conclusion that farms, or more properly farm businesses, should be taken as the individuals of the universe being classified. Incomes are earned by farm businesses. Any attempt to subdivide or aggregate farm businesses would lead to artificial criterion values. Then too, farms are bought, operated, mortgaged and otherwise handled as units and the interests of those dealing with farms and farmers in this state focus upon farm businesses as units. Next it seemed clear enough that the users of the maps would like them to record more than simply a summary of history; would like then to forecast the future if such could be done reliably. Forty years of farm management research, and experience with the original methods of classification, suggested that income appraisals might be made somewhere near as reliably as sale price appraisals done for credit purposes. The system then began to emerge as an income-expectancy classification of farm business units.

A re-examination of the maps made with earlier methods revealed that they in effect were income-expectancy classifications of farm business units in the areas where they had proven to be successful. The aspects of land use that had been examined in the classification process—kind of crops, size and condition of buildings, size of dairy herds, soil, topography, accessability, etc.—were good indicators of at least past and present incomes in these areas. But the method was found to be tailored to dairy farms more than to cash-crop farms. It was in the cash-crop areas of the Central Plain region of the state that the system had run into the most trouble.

It was at this point that a clear distinction began to be made between indicators and the criterion of the system. The criterion was reaffirmed to be income expectancy. But since this could not be measured directly, it was clearly necessary to have "bases" for judging it—factors that would serve to "indicate" it. Past incomes, measures of business size, rates of production, amount and condition of capital investments, performance characteristics of soil, climate, and topography, and like items, were identified as indicators. It was recognized that the reliability of given indicators, particularly those such as size of dairy herd and size of barn, would vary with type of farming. Indicators, therefore, were to be chosen thereafter to fit the conditions of the areas being classified, with the gen-

eral objective in the choice being one of gaining maximum reliability at minimum cost.

Attention was turned at the same time to a further examination of the income-expectancy concept. Clearly there are all sorts of uncertainties connected with estimates of future incomes. Yet agricultural credit agencies find it possible to operate, by the standards of success imposed in the business world, on estimates of farmers' incomes. They, of course, allow a safety margin by not loaning full value on any properties. At the same time, the classification system involves estimates of only relative income levels, except for the top of Class II, and involves placing individuals in only five classes rather than arraying them as individuals. True, time and resources available to the classification project are limited—the classification of all the farms in an average-sized county should not be allowed to exceed $30,000, including overhead. This precluded detailed examinations of every individual farm and precluded in particular gaining a personal acquaintance with each individual farmer and his managerial abilities.

A "most-probable-operator" concept was introduced at this point. Those working on the classification project had an extensive acquaintance with farmers in various areas of the state even though often not an acquaintance with many of the particular farmers in a given area being classified. They could visualize quite clearly the managerial abilities and capital resources of men most likely to acquire particular kinds of farms. It was decided therefore, that appraisals should be made in each instance with a most-probable operator in mind.

The most-probable-operator concept injects, of course, a probability element into the income-expectancy idea. Not all operators for farms even of a given kind will in fact have the characteristics of the single individual visualized as the most probable operator for farms of that kind.

And there are many other elements that expand the uncertainties involved in estimates of future incomes for individual farms. Changes in marketing arrangements, roads, taxes, and the like can upset expectations. New technologies, like bulk handling of milk, can substantially modify the relative competitive positions of various farms. Changes in the general price level can, of course, do likewise, for short periods at least. Then, too, farm businesses themselves—the things of which income is a characteristic—are undergoing a general and continuous evolution. Where there were three farms yesterday there may be only two tomorrow. Where cash outlays represented only ten per cent of capital investments back in history, they may represent fifty per cent today.

But there seemed to be no easy way around these difficulties and we did not want to retreat to the elaboration of history. Without an electronic

computer sufficiently complex to resolve the problem, it was entrusted to judgment. It was broken down, as far as possible, into systematic steps to avoid the hazards of global guesses. And we reconciled ourselves to the situation with the thought that we would succeed if we only did a better job than anyone else had done!

The mechanics of our classification studies now involve a sequence of operations that might be listed as follows:

1. Collection of basic information: This involves assembly of soil maps, climatic data, census information, airphotos, and the like. It also involves the collection of data in the field. This may be information on cow numbers taken from TB-test lists and located on maps by contacts with informed local people. It may be other semi-secondary information. A sample of open-country residents is also interviewed. Occupants of every Nth house—rates of $\frac{1}{5}$, $\frac{1}{8}$ and $\frac{1}{12}$ have been used in recent studies—are asked for a physical description of their farm business, a description of any nonfarm work, and dollar figures on their real estate and other farm business investments.

2. The preliminary classification: Next we take the information collected in step 1 into the field. We drive every road in the county, examining everything we can see that gives us clues to income expectancy. Our observations are combined with clues from the basic data and our appraisals of each farm are recorded as a categorical class designation beside each farmstead. In this work we use topographic maps, most of which now are at a scale of 2″ to the mile and fortunately are up-to-date and very accurate in most areas. At the end of each day, or at points from time to time during the day, we work on converting the categorical classification into the cartographic classification that we will publish.

3. Test-run tabulations: Survey data obtained in step 1, and the results of any other recent farm management studies in the county, are tabulated by land class as soon as the preliminary classification is completed. The results of these tabulations, which for the most part are set up as frequency distributions, are studied carefully for what they reveal of the intra-class homogeneity and inter-class heterogeneity we have attained. They also are compared with results attained in the previous studies, as part of our effort to maintain comparability in our classes throughout the state.

The characteristics tabulated are only indicators, not criteria. We do not expect the same values for the same classes in all parts of the state. Incomes are not related to given indicators in the same manner in all areas.

4. Field re-checking: The test-run tabulations often indicate deficiencies in the preliminary classifications. The re-checking that follows the test-run tabulations may involve a fairly widespread re-examination of areas in the county. More likely, however, it will mean only re-examination of areas recognized as marginal to the class in which they were placed in the preliminary work.

5. Checking with informed persons: This aspect of the work may accompany other steps or may be left largely toward the end of the study. County Agents often work closely with us during the study, sometimes spending a number of days in the field. We often talk at length with other college specialists and with informed farmers during the study. Occasionally, these checks are gotten by systematically visiting a list of leading farmers near the end of the study, by formally arranging tours, etc.

   We usually have occasion to change our maps at a number of points on the basis of new information brought to light in these contacts. Sometimes we change them simply because local people object too strenuously to our classification at some point. These maps, afterall, are an educational device. If people think we are too crazy at one point, they will pay no attention to the other things we say. We must lead but not be so far ahead that the truths we speak are not heard where it counts.

   (Incidentally, our land classification work is considered as much an extension as a research effort; perhaps more.)

6. Preparation of final maps and tabulations.

In an increasing number of instances in recent years, we have recognized situations in which farming today appears to fall quite clearly short of the incomes that could be realized. The troubles we encountered in the Central Plain region of the state arose in part because farmers in some areas began to see developmental opportunities and to exploit them. This happened in so many areas during the 1940's and early 50's that we were much impressed. These were not simply the consequences of a temporary price situation. The changes involved farm consolidations, building investments, changes in type of farming, and changes in many specific farming practices. The results have permanently changed income expectancies. And when we stopped to look, it seemed that we should have been able to predict the possibility of these changes.

If the probability of early development is high, of course, we now take this into consideration in making our standard classification. If the possibility of development appears real, but its likelihood is more remote, we

now classify the farms according to the incomes expected in the nearer future, then add an "X" to the class numeral to indicate developmental possibilities. In all cases we point out the fact that development in agriculture ordinarily involves the investing of capital that cannot be recovered on resale. The best buy is a farm that already is developed, if you can afford it and are willing to move where necessary.

We also are using a "Y" sub-class at the present time. This denotes areas that are expected to slide downward slowly relative to others, on the income expectancy scale. The heavy clays located among rock outcrops in the northern part of the state have supported prosperous farming, for example, but will not respond so generously to further efforts at intensification as will the lighter soils in the area. Agriculture is expected to become more intensive in the North Country, and farms on the clays are expected to decline slowly in their net income producing power as a consequence. If these farms were put in a low numerical class, local people would be less likely to believe the prediction than if the numerical designation were chosen to reflect prospects for the near future and a letter added to indicate the somewhat more remote troubles ahead.[4]

I have said nothing yet about our theoretical foundations; about how we reconcile our classification scheme with traditional theories of land use and farming returns.

The Ricardian residual-claimant theory is easiest to work with at this point, although it has been superseded by marginal productivity theories of distribution. The net result is the same regardless of which form of theory is used.

Ricardian theory visualized grades of land described in terms of production functions, the production functions reaching successively higher points on successive grades of land. High points are also reached at successively higher input levels on successive grades of land. It is presumed that marginal costs and marginal returns are equilibrated by the operators of each grade of land. The more responsive land is operated more intensively as a result. All non-land factors are presumed to be freely mobile and therefore to have a "going" price throughout the area. Only the proceeds from production left after non-land inputs are paid their going rates, go to the land owner. But land owners buy land with a knowledge of these returns and pay prices such that their return will net them the going rate of interest on their investment. Operators are free to adjust their acreages to attain business sizes that will keep them fully employed.

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[4] Seventeen counties were classified prior to World War II by the older methods. Six counties have been classified since the war. A current project aims to produce a semi-detailed map for ten additional counties, relying heavily on airphoto interpretation.

Since their return is at a "going" rate, it is then concluded that their incomes will be equal on any grade of land being used for farming. The lowest grade of land in use will return nothing to its owner, but also will sell for nothing. Lower grades of land will not be used.

This is a beautiful picture. But it is painted out of someone's imagination. It is deductively correct but highly unrealistic. The real world is not made this way. Interestingly enough, however, the real world does have some discernable patterns in it that deviate in a fairly consistent manner from this picture. The picture is unrealistic, but it is not unrelated to the real world.

The trouble in this theory traces, of course, to its assumptions. All non-land factors are assumed to be freely mobile, and more than that, to move with a full knowledge of the returns that can be gotten in various positions.

Some non-land factors are mobile and have a going price. This holds for tractors, feed, seed and many items. They have a price. If you do not pay it, you do not get them. But this does not hold for men. A farmer's mobility is very much circumscribed by his command over capital. And capital is not freely available at its so-called market price. It happens, further, that the distribution of farmers by their command over capital is a highly skewed distribution. Few have much and many have little. The many bid strongly against each other for the farms with prices that are within their reach. The others get their higher priced farms with less competition.

Beyond this, who would maintain that everyone in the land market is fully aware of his income possibilities on all of the different farms he might operate? What is the likelihood that all prospective purchasers ever will be aware of this? Lack of full knowledge leads to insufficiently keen differentiation among grades of land; leads to a tendency to pay too much for unresponsive land and too little for responsive land. This tendency re-inforces the tendency that results from a skewed distribution of command over capital. The result is expressed frequently by the statement, "Poor land is over priced and good land is underpriced."

This over-and-under-pricing is not a constant, however. Where different kinds of land are unmistakably differentiated this tendency often is small. This holds for the lands above and below a high-line ditch at the edge of an irrigation district. If one compares income expectancies in a large grazing area with those in a large irrigated area he may find them equal, notwithstanding the difference in the responsiveness of the land. Knowledge is relatively perfect here, and frequency distributions of farms by total capital investments may be almost identical in the two areas, thus eliminating the effect of the skewed distribution in command over capital as between the two areas.

Thus we believe that traditional theory was only a good first approximation and that a valuable revision of it has resulted from our empirical efforts—a revision that explicitly introduces allowances for various degrees of imperfect knowledge and for the effect of a skewed distribution of command over capital where farms of widely different prices are intermingled.

Before closing I should point out emphatically that the Cornell system of classification cannot be everything to all men. There are places where a map simply cannot be drawn that will portray geographically localized differences in income expectancies. Instances of village agriculture and of areas of highly fragmented farm units are examples. There are places where a picture of income expectancies simply carries no information of value to anyone. Areas with low incomes throughout, where the problems are ones of how to get out or how to keep body and soul together if you cannot escape are instances in point. In other cases, questions regarding kinds of land use are paramount, or problems of rearranging institutional patterns, and the like.

It has simply happened that the Cornell system of classification has proven useful in New York State. It conveys information and judgments that interest people. It also has proven useful in some other parts of the United States and Canada. I think it could be useful in additional areas, but I know it cannot be useful everywhere.

ARE FARMERS MORE VULNERABLE TO THE PRICE-COST SQUEEZE?

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ARE farmers more vulnerable to a price-cost squeeze than formerly? Many observers think so. They are particularly alarmed by the following changes which have occurred since the early 1930's:

1. Farmers have shifted from the use of animal power and large amounts of man labor to tractor power and more machinery.

2. A higher proportion of total inputs are purchased items. This results in part from increased size.

3. Farmers use more nonfarm-produced items such as commercial fertilizer and pesticides. These items tend to have more rigid prices than feed, seed, livestock, and farm wage rates.

The purpose of this article is to evaluate the extent to which shifts in technology and organization have left farmers more vulnerable to a price-cost squeeze. Unfortunately, there is no commonly accepted definition of vulnerability in the economic sense. Webster defines vulnerable as "capable of being wounded." To apply this to economics, we must specify what we mean by "wounded." Some economists refer to the reduction in net farm income as the price-cost relationship becomes less favorable. They do not say whether the reduction is measured in relative or absolute terms. When comparing farm operations with different incomes this makes a difference. Other economists refer to the amount of income left after a reduction in the price-cost relationship has taken place. They are particularly concerned about the ability of farmers to avoid bankruptcy. Both concepts of vulnerability are important and both are examined in this article.

Method of Analysis

Ten types of farms representing a wide variation of conditions in the United States were chosen for analysis.[1] The general approach was to determine net farm income as progressively less favorable prices and cost rates were applied to quantities sold and purchased on each type of farm as it was operated in the early thirties. Then, these incomes were compared with corresponding incomes as the same price and cost rates were applied to the quantities sold and purchased on each type of farm as operated in the middle fifties. The difference in quantities purchased and sold between the early thirties and middle fifties reflect changes that have occurred in size, organization, and technology. For lack of a better term,

[1] Data for this analysis are taken from the cost and returns series on commercial family-operated farms, Farm Economics Research Division, ARS.

these quantities purchased and sold in each period are referred to as the prewar and postwar operations, respectively. The effect of weather was eliminated by choosing one or more years in each period when yields for the particular type of farm averaged about "normal" for the respective periods.

For each period, net farm income was first calculated at 1947-49 prices. This gave a comparison of the two farm operations at relatively favorable price-cost relationships. Then 1957 prices were used to show the effect of a moderate price-cost squeeze on net farm incomes for operations in both periods.

Next, assumed price-cost relationships less favorable than those in 1957 were used to determine the effect of a more severe price-cost squeeze. Prices received were reduced 30 per cent from 1957. Feed, seed, livestock prices, and farm wages were reduced 25 per cent, machinery 3 per cent, and all other purchased items 12 per cent below 1957.

Last, with no further reduction in prices paid, prices received were reduced to the point where the incomes were equal for both period operations. (This was possible because the reduction in income on the postwar operations exceeded the reduction on the prewar operation.)

In the last two steps, farm wage rates and prices paid for machinery, feed, and so on, were reduced by different amounts to reflect the effect of shifting from production items with flexible prices to items with inflexible prices. The assumed reduction in prices paid is patterned after the reduction that occurred in the 1920-22 and 1929-33 periods. These were the only periods after World War I when prices paid declined by substantial amounts. Prices paid for feed, seed, and livestock, and farm wage rates generally, declined more than the average of all commodities used in production. Prices paid for machinery declined much less than all commodities. However, from 1947-49 to 1957, farm wage rates increased faster than most other cost rates. But in this later period, industry was prosperous, whereas in the 1920-22 and 1929-33 periods, both industrial production and prices declined.

Prices received for all products sold were reduced by the same amounts. For most of the important products sold, examination of the history of prices received did not reveal a consistent pattern in which some prices changed more than others.

The most satisfactory picture of the effect of changes in technology and organization on vulnerability may be obtained from a graph of the net farm income for the operation in each period at various price-cost relationships. However, two indicators have been worked out in an attempt to provide simple measures of vulnerability in each of the respects mentioned above.

The first indicator is based on the situation in which prices received are reduced 30 per cent from 1957. The reduction in net farm income on the postwar operation is expressed as a percentage of the reduction in income on the prewar operations. For example, suppose the reduction in net farm income is $500 on the postwar operations and $300 on the prewar operations. The relative or index becomes 500/300 or 167 per cent. If we measure vulnerability by dollar reduction in net farm income, an index greater than 100 means that vulnerability has been increased by the change from the prewar to the postwar operations.

The second measure is based on the fact that as the price decline becomes more severe, the net income advantage of the postwar operations over the prewar operations becomes progressively smaller. If the price decline goes far enough this advantage becomes negative. The measure is simply the percentage reduction from 1957 in prices received that will reduce net farm incomes on the operation in each period to the same level. Other things being equal a large reduction in prices received means that the postwar farm operation can take a large reduction in price-cost relationships before it will provide less money to meet a given set of obligations than the prewar obligations would provide.

This analysis assumes that the farmer is free from debt and that the period of unfavorable price-cost relationship is too long for a farmer to delay replacement of machinery and buildings. However, for purposes of illustration the analysis was modified on cash grain farms in the Corn Belt to show how much money would be available for family living if payments were made on a farm mortgage. Also, modification was made to show money available for family living if the period of severe price-cost squeeze were short so that the farmer could delay replacement of machinery and buildings.

Changes from Prewar to Postwar Period

On the 10 types of farms selected for this study, the general pattern of changes in cost structure and efficiency was similar but the timing and magnitude of the changes varied greatly from farm to farm. Size of operation increased on all types of farms, whether measured as total land farmed, total inputs, or net farm production. Measure of total inputs[2] (which include land, working capital, family and operator labor, and purchased goods) is probably the best measure of change in size and this is the measure used mainly in this analysis (Table 1).

On all except winter wheat farms in the Southern Plains, purchased inputs accounted for a larger proportion of total inputs in the postwar than in the prewar period.

[2] In measuring total inputs and efficiency, 1947-49 prices are used as weights.

TABLE 1. INCREASE IN INCOME, SIZE, AND PURCHASED INPUTS AS A PROPORTION OF TOTAL INPUTS ON SELECTED COMMERCIAL FAMILY-OPERATED FARMS IN PREWAR AND POSTWAR PERIODS[1]

Type of Farm	Years Included in Period		Relative Increase from Prewar to Postwar Period in—			Purchased Inputs as a Percentage of Total Inputs		
	Prewar	Postwar	Net farm income	Total inputs	Production per unit of input	Prewar	Postwar	Increase
			Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Dairy, Central Northeast	1930–38	1953–57	85	31	24	61	67	6
Cotton, Southern Piedmont	1930–32	1954–56	18	7	9	60	65	5
Winter wheat, Southern Plains	1930–38	1954–55	23	11	4	53	50	−3
Hog-beef raising, Corn Belt	1930–38	1954–57	108	37	41	38	49	11
Tobacco-livestock, Kentucky	1931–38	1954–57	20	17	9	43	52	9
Cash grain, Corn Belt	1930–32	1954–55	74	27	34	42	54	12
Wheat-small grain-livestock, Northern Plains	1930	1954–56	103	20	37	52	54	2
Dairy, Western Wisconsin	1930–34	1953–57	48	26	34	31	51	20
Hog-beef fattening, Corn Belt	1930–32	1954–57	69	59	14	57	71	14
Cotton, Black Prairie	1930–31	1955	14	34	4	48	64	16

[1] 1947–49 prices used as weights.

The composition of items purchased also changed from the prewar to the postwar period. On all farms, the proportion of purchased inputs accounted for by hired labor declined. The greatest decline, from 57 to 26 per cent, occurred on cotton farms in the southern Piedmont. The smallest decline, from 14 to 5 per cent, occurred on hog-beef fattening farms in the Corn Belt. The proportion of purchased inputs for machinery increased on all except the hog-beef fattening and hog-beef raising farms. Even here the quantity of machinery bought increased, although less rapidly than other inputs. The largest increase, from 26 to 43 per cent, occurred on wheat-small grain-livestock farms in the Northern Plains. The increase on most other types of farms amounted to about 10 percentage points. The quantity of commercial fertilizer increased substantially on most types of farms. In the postwar period, commercial fertilizer on cash grain, southern Piedmont cotton, and tobacco-livestock farms accounted for more than 10 per cent of the purchased inputs. In the postwar period, feed, seed, and livestock (farm-produced inputs) also accounted for a larger proportion of purchased inputs on the three Corn Belt farms, the Central Northeast dairy farms, and the winter wheat farms in the Southern Plains.[3]

As a result of the increase in size and the changes in composition of farm inputs noted above, production per unit of input increased on all types of farms. This means that at 1947-49 price relationships, production was more efficient in the postwar than in the prewar period.

When net farm income is computed at 1947-49 prices, the postwar period operation gives the highest income on all types of farms. The increase in net farm income is associated with the relative increase in size

[3] For further discussion of this point, see "Farm Costs and Returns, 1956, with Comparisons," U. S. Dept. Agr. Agr. Inform. Bul. 176. June 1957.

and the improvement in efficiency. On dairy farms in western Wisconsin, the percentage increase in income is not as large as would be expected from the increase in size and efficiency. This is because the increase in efficiency reported is due largely to a reduction in family labor—a benefit that does not show up in net farm income.

Effect of Changing Prices from 1947-49 to 1957

When prices are changed from 1947-49 to 1957, net farm incomes are reduced on all farms except for the prewar operations on the tobacco-livestock farms (Table 2). In each instance, the reduction in income in terms of dollars for the postwar operations is *greater* than for the prewar operations. However, only 5 types of farms showed a larger percentage reduction in net farm income for the postwar operations. On the other 5 types of farms, the net farm income for 1947-49 with the prewar operations is so low that a small reduction in net farm income gives a relatively large percentage decline compared with the change for the postwar operations. For this reason, a comparison of the percentage reduction in income frequently does not give a wholly satisfactory measure of the variation in net farm income.

At 1957 prices, net farm incomes from the postwar operations are higher than incomes from the prewar operations on all except the cotton farms in the Black Prairie. This happens despite the fact that, when prices were changed from 1947-49 to 1957, net farm incomes from the postwar operations declined more than those from the prewar operations. At 1947-49 prices, the net farm income from the postwar operation is usually so much higher than the income from the prewar operation that a large reduction can occur before this income advantage is lost. Usually, the effect of larger size and increased efficiency on the relative incomes from operations in the two periods was more than enough to offset the cost-price squeeze that occurred from 1947-49 to 1957. This means that unless the price-cost squeeze gets worse than it was in 1957, most farmers who have increased the size of their farms and adopted new technology are in better position to meet a given set of financial obligations than those who have made no changes.

As prices were changed from 1947-49 to 1957, the reduction in net farm income on postwar operations relative to the reduction on prewar operations varied considerably. This is because both the physical factors and price relationships change more on some farms than on others.

In general, prices received for feed grains, livestock, and livestock products declined more than prices received for cotton and wheat. The greatest reduction in prices received occurred on farms on which feed grains and livestock production were relatively important. When production of feed

TABLE 2. NET FARM INCOME WITH 1947–49 AND 1957 PRICES

Type of Farm and Period	Net Farm Income		
	Prices		Reduction
	1947–49	1957	
	Dollars	*Dollars*	*Dollars*
Dairy, Central Northeast:			
Postwar	5,514	4,488	1,026
Prewar	2,988	2,014	974
Cotton, Southern Piedmont:			
Postwar	1,758	1,423	335
Prewar	1,485	1,178	307
Winter wheat, Southern Plains:			
Postwar	7,496	5,384	2,112
Prewar	6,096	4,307	1,789
Hog-beef raising, Corn Belt:			
Postwar	5,280	3,247	2,033
Prewar	2,540	1,312	1,228
Tobacco-livestock, Kentucky:			
Postwar	3,245	3,201	44
Prewar	2,712	2,833	−121
Cash grain, Corn Belt:			
Postwar	10,557	5,671	4,886
Prewar	6,077	2,832	3,245
Wheat-small grain-livestock, Northern Plains:			
Postwar	7,694	3,853	3,841
Prewar	3,789	2,067	1,722
Dairy, Western Wisconsin:			
Postwar	4,209	2,520	1,707
Prewar	2,851	2,020	831
Hog-beef fattening, Corn Belt:			
Postwar	12,504	5,576	6,928
Prewar	7,386	3,895	3,491
Cotton, Black Prairie:			
Postwar	3,220	1,903	1,317
Prewar	2,822	2,183	639

grains and livestock increased relatively more than production of cotton, wheat, or tobacco, average prices received for the operation in the postwar period declined more than for the prewar operation.

Similarly, the increase in prices paid varied from farm to farm, depending on the relative importance of individual items purchased. In general, the prices paid for machinery increased more than the prices of other items purchased, such as commercial fertilizer. Prices paid for feed, seed, and livestock declined from 1947-49 to 1957. The increase in farm wage

rates varied by areas. Where farm wage rates increased more than the average of all commodities used in production, the increase in average prices paid was greater for the operation in the prewar period than for the operation in the postwar period. This was because hired labor on all farms decreased in relative importance from the prewar to the postwar period.

As a result of these changes in prices and the shifts in relative importance of various products, the ratio of prices received to prices paid decreased more on some farms than on others. The decrease in this ratio for the postwar operation was greater than for the prewar operation on 5 types of farms, the same on 1 type of farm, and less on 4 types of farms.

Further Reduction in Price-Cost Relationships

When prices received are reduced 30 per cent below 1957, and prices paid are reduced 3 per cent for machinery, 25 per cent for feed, seed, livestock, and farm wage rates, and 12 per cent for all other items, the results are similar to those obtained when prices are changed from the 1947-49 to the 1957 level (Figure 1). The resulting reduction in net farm income is from 27 to 102 per cent greater with the postwar operations than with the corresponding prewar operations. On 8 types of farms, however, the highest net farm income is still obtained with the postwar farm operations. On 5 types of farms, prices received must be reduced by 54 per cent or more before the advantage of the postwar operation is eliminated. The ratio of prices received to prices paid would be reduced by 50 per cent or more below 1957.

Space does not permit a thorough discussion of the factors affecting the changes in variation in net farm income but the following conclusions are evident from Table 3:

1. As less favorable price-cost relationships are used, the greatest reduction in net farm income with the postwar operations relative to the reductions on the corresponding prewar operations tends to occur on farms that show the largest increase in volume of production (total inputs × efficiency). This factor appears to be the most important factor leading to greater reduction in net farm income.

2. The shift from the use of production items with flexible prices to items with inflexible prices contributed to greater reduction in net farm income on the postwar operation of 8 types of farms. When the index showing the reduction in net farm income is recalculated assuming the same average change in prices paid for the postwar operations as the prewar operations, the index is reduced from 8 to 20 points on these farms. (The influence of this shift is reflected in the difference between the index of prices paid with the prewar operations and the postwar operations.)

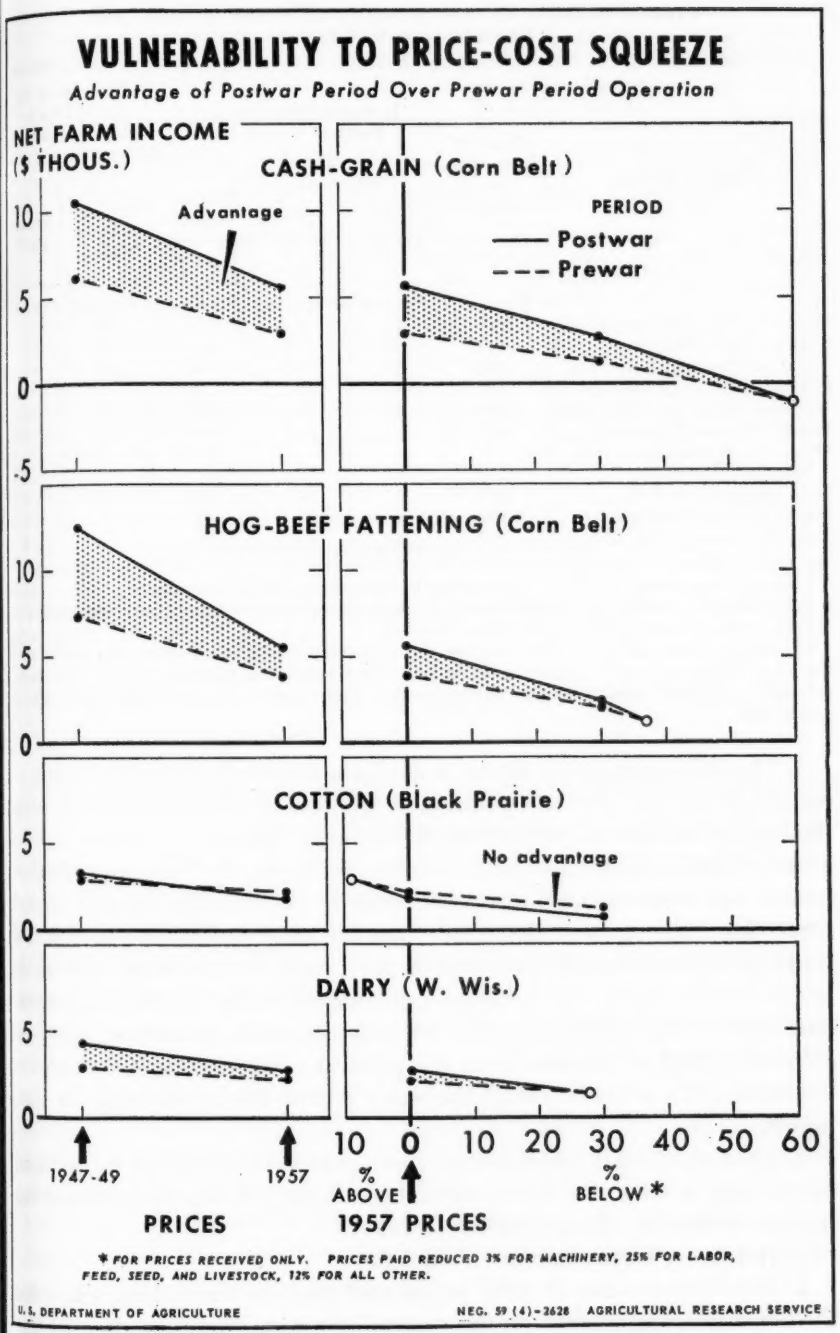
VULNERABILITY TO PRICE-COST SQUEEZE
Advantage of Postwar Period Over Prewar Period Operation
NET FARM INCOME ($ THOUS.)
CASH-GRAIN (Corn Belt)
Advantage
PERIOD
Postwar
Prewar
10
5
0
-5
HOG-BEEF FATTENING (Corn Belt)
10
5
0
COTTON (Black Prairie)
No advantage
5
0
DAIRY (W. Wis.)
5
0
1947-49
1957
10 0 10 20 30 40 50 60
% ABOVE
% BELOW *
PRICES
1957 PRICES
* FOR PRICES RECEIVED ONLY. PRICES PAID REDUCED 3% FOR MACHINERY, 25% FOR LABOR, FEED, SEED, AND LIVESTOCK, 12% FOR ALL OTHER.
U. S. DEPARTMENT OF AGRICULTURE
NEG. 59 (4)-2628 AGRICULTURAL RESEARCH SERVICE

FIG. 1

TABLE 3. RELATIVE CHANGE IN NET FARM INCOME AS PRICES ARE REDUCED FROM 1957 LEVEL

Type of Farm	Relative Reduction in Income[1]	Increase from Prewar to Postwar Period in—			Increase in Indexes Due to Shift in Production Items Used	
		Total Inputs	Efficiency	Proportion of Purchased Inputs[2]	Reduction in Income[3]	Prices Paid[4]
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Winter wheat, Southern Plains	127	11	4	−3	9	3
Cotton, Black Prairie	127	34	4	16	14	4
Tobacco-livestock, Kentucky	130	17	9	9	10	4
Cotton, Southern Piedmont	140	7	9	5	17	5
Hog-beef fattening, Corn Belt	156	59	14	14	−6	−1
Dairy, Western Wisconsin	161	26	34	20	12	3
Wheat-small grain-livestock, Northern Plains	179	20	37	2	20	4
Cash grain, Corn Belt	182	27	34	12	8	1
Dairy, Central Northeast	192	31	24	6	8	2
Hog-beef raising, Corn Belt	202	37	41	11	−2	−1

[1] Change in postwar income as percentage of change in prewar income.
[2] Percentage of total inputs purchased in postwar operations minus corresponding percentage with prewar operations at 1947–49 prices.
[3] Index of reduction in net farm income minus corresponding index when calculated with the same average change in prices paid on postwar operation as used on prewar operations.
[4] Index of prices paid with postwar operation minus index of prices paid with prewar operations.

3. The difference in reduction in net farm income between the postwar operation and the prewar operation is greatest on the farms which have the largest increase in proportion of purchased inputs.

Some factors that contribute to vulnerability in the first sense (reduction in net farm income) also contribute to vulnerability in the second sense (level of income). But farms that are most vulnerable in the first sense are not necessarily the same as the farms that are most vulnerable in the second sense. This is because greater efficiency, which is an important factor contributing to greater reduction in net farm income, also contributes to higher incomes from the postwar compared with the prewar operations. To a lesser extent the same is true for an increase in total inputs.

In general, the 5 types of farms where prices received may be reduced 54 per cent or more before the advantage of the postwar operation is lost had the following characteristics (Table 4):

1. Relatively large increase in efficiency.
2. Net farm income at 1957 prices and postwar operations, exceeded the corresponding income on the prewar operations by more than $1,000.
3. A small increase, or none, in the proportion of purchased inputs.

TABLE 4. CHANGES IN PRICES RECEIVED THAT WILL GIVE THE SAME INCOME ON PREWAR AS ON POSTWAR OPERATIONS

Type of Farm	Change in Prices Received[1]	Increase from Prewar to Postwar Period in-			Difference in Index of Prices Paid[3]
		Total Inputs	Efficiency	Proportion of Purchased Inputs[2]	
	Per cent	*Per cent*	*Per cent*	*Per cent*	*Per cent*
Winter wheat, Southern Plains	−67	11	4	−3	3
Dairy, Central Northeast	−66	31	24	6	2
Hog-beef raising, Corn Belt	−63	37	41	11	−1
Cash grain, Corn Belt	−60	27	34	12	1
Wheat-small grain-livestock, Northern Plains	−54	20	37	2	4
Hog-beef fattening, Corn Belt	−37	59	14	14	−1
Tobacco-livestock, Kentucky	−33	17	9	9	4
Cotton, Southern Piedmont	−31	7	9	5	5
Dairy, Western Wisconsin	−28	26	34	20	3
Cotton, Black Prairie	9	34	4	16	4

[1] That will give the same income for the operations in each period.
[2] Percentage of total inputs purchased in postwar operations minus corresponding percentage with prewar operations at 1947–49 prices.
[3] Index of prices paid with postwar operation minus index of prices paid with prewar operations.

4. A small shift, or none, from production items with flexible prices to items with more rigid prices.

To What Extent Can Cash Outlay Be Deferred on the Two Operations?

If the period of price-cost squeeze is of short duration, farmers can maintain expenditures for family living by delaying some capital investment. This would increase the advantage of the postwar organization. Since farmers with the postwar operations would have larger investment in machinery and buildings, they might be able to reduce cash outlay more than farmers with the prewar operations.

For example, on cash grain farms in the Corn Belt, cash expenditures for new machinery and buildings are $1,930 on the postwar operations and $1,150 on the prewar operations. (Prices paid for machinery and buildings are 3 and 12 per cent, respectively, below 1957.) If all of these expenditures could be delayed without additional repair costs, the postwar operation would have an advantage of $780. This advantage undoubtedly would become less as the duration of the price-cost squeeze was extended. This is because repair costs would be higher or some capital investment would become necessary.

Joint ownership of machinery or custom work provides other possibilities of holding down major expenditures for capital items.

Effect of Debt

As an example, the effect of debt on amount of money available for family living on cash grain farms was calculated. A 20-year mortgage at 5 per cent was assumed for all the additional investment in land and buildings on the postwar operation. Also a 5-year loan at 6 per cent was figured on the additional working capital. Probably few farmers would go into debt for all the additional investment needed to increase size and adopt new technology, but adjustments may be made for debt of a smaller amount.

At 1947-49 prices, interest and payments on the principal reduced the money available for family living by $2,006. When 1957 prices were used the reduction was $2,214. The increase was due to higher land values. At 1957 prices, the postwar operation provided only $625 more for family living than the prewar operation. This compared with $2,839 when no debt was assumed on the additional investment. When prices received were reduced 30 per cent below 1957 the postwar operation provided $696 less money for family living than the prewar operations.

Conclusion

We cannot say unequivocally that farmers are more or less vulnerable to a price-cost squeeze than they were before World War II. If vulnerability means the dollar reduction in net farm income following a price-cost squeeze, then farmers have become more vulnerable than they were before World War II.

But if vulnerability means the ability to survive a period of unfavorable price-cost relationships, then the postwar operations on most types of farms are less vulnerable than the corresponding prewar operations. However, if the price-cost squeeze becomes very severe this situation is reversed. A much greater reduction in the price-cost relationship is required on some farms than on others to bring about this reversal. The debt position of the individual farmer will greatly affect the reduction in price-cost relationship which can occur before the advantage of the postwar operation is eliminated.

Certain factors, such as increased proportion of purchased inputs and the shift to production items with rigid prices, tend to increase vulnerability in either sense the term is used. However, when considering the ability of farmers to survive a price-cost squeeze, increased efficiency is usually more than enough to offset the influence of these factors.

DETERMINING THE EFFECT OF SIZE OF HERD AND EQUIPMENT ON DAIRY CHORE LABOR*

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THE recommendations made to farmers by farm management specialists often appear to imply that economies of size exist. The relevant input-output coefficients, however, are seldom known. Since machines and equipment are often changed as the size of the enterprise is increased, care must be taken to distinguish properly between the effects of size of enterprise and of differences in equipment on labor coefficients.

This paper deals with the problem of measuring the amount of labor used in caring for the dairy herd under various conditions. The objectives are to present a method for determining 1) the relationship between the amount of labor used in dairying and herd size for some of the more common combinations of equipment and 2) the seasonal distribution of the labor used.

Alternative Formulations of the Problem

In general, the problem can be stated as a choice of procedures for determining the effects of size of herd and system of management on the amount of labor used on the dairy enterprise in a year and at different times within the year. The dairy production year divides naturally into two parts: the winter or barn feeding season, and the summer season when most of the animals are on pasture. Labor requirements are usually much lower in summer than in winter because in summer such tasks as feeding hay and silage may be eliminated and less labor is needed for other tasks, such as bedding and barn cleaning. Therefore, information on labor is needed during the barn feeding and the summer pasture seasons. Labor for the year is expressed as the sum of the labor used during these two seasons ($L^Y = L^W + L^S$). There are two alternative ways of stating the problem for a season: 1) the total labor formulation and 2) the task function formulation.

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* Paper No. 4015, Scientific Journal Series, Minnesota Agricultural Experiment Station.

** At the time the study was made, Aune was Research Fellow, University of Minnesota. The authors thank E. W. Learn, W. W. Cochrane, H. R. Jensen and C. E. Gates, Minnesota Agricultural Experiment Station Statistican, for helpful suggestions during the preparation of this manuscript. The authors wish to acknowledge some financial support for this study under North Central Technical Committee No. 28. The empirical analysis is based on the results of a study of adjustments in dairy farming conducted cooperatively by the Minnesota Agricultural Experiment Station and the Farm Economics Research Division, ARS, U. S. Department of Agriculture.

Total labor formulation

As the name implies, the total labor formulation involves measuring labor as the sum of all labor used on all tasks in caring for the dairy herd during a particular season of the year.

More specifically:

$$L_i^W = f(X_1 | X_2, X_3, \cdots, X_n)$$

In which L_i^W is the total amount of labor used for dairy chores during the winter season with the ith combination of variables $X_2, X_3, \ldots X_n$; X_1 is a quantitative variable indicating the total number of animals or a combination of animals cared for, and $X_2, X_3, \ldots X_n$, are quantitative and qualitative variables, that describe a system of management. These variables include such items as the number of workers, barn arrangements, work procedures, and the combination of equipment used in the various tasks.

This model dictates the identification of a group of production units which are homogeneous with respect to all variables $X_2, X_3, \ldots X_n$ and differ only with respect to the number of cows, X_1. A number of groups that differ in system of management can be identified and estimates can be made as to the relationship between number of animals and the labor used for each management group. Comparison of the functions then provides the means for analyzing the economy of alternative types of equipment, barn arrangements, and work procedures for dairy herds of various sizes. This model is straightforward in its approach, but a question arises as to its efficiency and the feasibility of proceeding in this way because of the great heterogeneity in dairy-chore equipment and work procedures. For example, common types of milking equipment are two and three unit milkers in barns with rows arranged lengthwise or crosswise; two cooling methods include a mechanical can cooler and a bulk tank; and grain may be fed once a day or twice a day, with or without feed carts, in barns with rows of stanchions lengthwise or crosswise. This with, say four milking, two milk-cooling, four grain-feeding, eight silage-feeding, four hay-feeding, and three manure-disposal methods, there would be 3,072 possible combinations. While it is possible that not all of these combinations would be found in reality, there was no evidence as to the frequency of occurrence of the various combinations, nor was it possible to conclude, *a priori*, that no significant differences existed between certain combinations. Clearly the size of sample required using this level of aggregation, total labor used to care for the dairy herd, was larger than the resources available for the study would permit. A lower level of aggregation (the total labor used for each task, for example) would allow the use of a smaller sample. Furthermore, the results obtained for each task could be

combined into a large variety of aggregates and thus permit considerable flexibility in the use of the results.

The task function formulation

Each L^W or L^S of the model described could be considered as the sum of a number of functions specified for each task during a particular season of the year.

With the ith equipment combination for example:

$$L_i{}^S = L_{M1}{}^S + L_{C1}{}^S + L_{G1}{}^S + L_{H1}{}^S + L_{S1}{}^S + L_{F1}{}^S + L_{O1}{}^S$$

in which the first subscript in each term of the summation indicates the task—milking, cleaning of utensils, grain feeding or hay feeding—and the second subscript identifies the method used in accomplishing the task.[1] Each term of the summation is also a function of other variables. For example, labor used for milking in the summer can be expressed as

$$L_{M1}{}^S = f(X_1 | X_2, X_3, \cdots, X_n)$$

in which the labor ($L_{M1}{}^S$) is some function of the number of cows milked (X_1) given a certain combination of qualitative and discrete variables ($X_2, X_3, \ldots X_n$), which describes the method of milking. These variables represent only those factors that affect milking time, such as number of workers, number of milking machines, and barn arrangement.

In contrast with the first formulation, which requires a minimum of 30,720 observations to place a minimum of 10 observations in each cell or group, the second formulation requires a minimum of only 80 observations to place a minimum of 10 observations in each of 3,720 cells or groups. This is only a possibility, as the probability of filling 3,720 groups with only 80 observations is low.

A comparison of the two alternative formulations shows that the task function model has the advantage of permitting a smaller sample. A further advantage is the ease with which it can be kept up to date as new equipment or work procedures are developed. A new milking procedure can be incorporated into the estimates of labor used by merely substituting the equation describing the new method for the one describing the old method.

Yet, in regard to current uses of resulting information, both models provide precisely the same information. Selection of a model depends on other considerations, particularly those associated with collection of data.

[1] This formulation involves an additional assumption, that of independence. This condition can be satisfied only if care is taken in the aggregation. For example, if in a particular season the type of product, Grade A or manufactured milk, affects the amount of labor used for milking and for disposal of manure, then both milking and manure disposal functions must involve the type of product as a variable. Furthermore, within a type of product it is assumed that the amount of labor used for feeding a cow is independent of the labor used for milking.

Methods of Data Collection

In collecting data on labor coefficients, several methods have been used. They include the single survey, quarterly surveys, stop watch timing procedures and detailed cost route methods. Among these four alternatives, the single survey has the advantage of speed in the collection of data, but the problem of memory bias becomes particularly important if an attempt is made to determine labor coefficients for different seasons of the year. Consideration of memory bias is important because many solutions of optimum farm plans in the Corn Belt derived by linear programming methods have shown extreme sensitivity to changes in quantities of labor available, particularly in seasons of peak demands on the labor supply. Obviously if small changes in the quantity of labor available can change optimum solutions, the same result can be accomplished by changes in labor coefficients. Another consideration is that respondents find it difficult to break down the total time needed for dairy chores into the time used for each task. Thus, use of the single survey method appears to dictate use of the total labor approach, (the first formulation) with minor, if any, emphasis on seasonal distribution of the labor used in dairying.

The quarterly or multiple-survey method would probably diminish memory bias relative to the single survey, particularly in relation to the seasonal distribution of labor. Furthermore, use of the multiple survey would give an opportunity for training farmers to observe the time required for each of several tasks as opposed to observing only the total time used per day in caring for the herd. However, memory bias would likely be a problem in connection with irregular tasks, such as cleaning sheds for young cattle, caring for sick animals, and other miscellaneous tasks.

Stop watch timing procedures would likely be more accurate in measuring the time used for routine tasks. But this method was not given serious consideration in the study because of the high cost of collecting data. Furthermore, it would need to be supplemented with other methods to obtain adequate data on irregularly occurring tasks.[2]

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[2] It should be recognized, however, that time and travel data have been used, in a manner similar to the task function formulation, to synthesize labor inputs for various sizes of enterprise. Orlin J. Scoville in "Synthesis of Labor Inputs for Hogs from Time-Study Data," *Journal of Farm Economics*, Vol.31, August 1949, pp. 549-555, indicated that "Time study data permit development of input requirements for a specified set of conditions, while survey data usually conceal wide difference in size of enterprise, equipment and practices used, and soil and weather conditions." Nevertheless in criticism of the time-travel type of study he concluded, "Stop watch studies tend to show minimum requirements. The person studied, knowing he is being watched, probably devotes his attention more strictly to the job at hand than he usually would. He may also move at a smarter pace than is

As traditionally conducted, the detailed cost-route method was given little consideration because of cost. However, daily recording of labor used on various jobs (a traditional characteristic of this method) tends to reduce memory bias to a minimum. Because the method requires considerable effort on the part of cooperating farmers, it tends to reduce the number who are willing to participate in a study of this kind.

Because of the considerations discussed, a "mail-in record" method was considered as a means of combining many of the features of the quarterly or multiple survey and detailed cost route methods. The method involves making arrangements with farmers to complete a daily record for one week in each month to indicate the labor used for each routine task of caring for the dairy herd. These tasks include such items as milking, cleaning and preparing milking equipment, feeding grain, feeding hay, and feeding silage. The completed record is sent to the university. To further minimize the possibilities of memory bias, the labor used on irregular or nondaily tasks is recorded and mailed in at the end of each month with the daily record of routine tasks. This system requires less effort on the part of the cooperating farmers than the traditional detailed labor or cost route study, and it tends to reduce the possibility of memory bias associated with the quarterly or multiple survey. This reduction is particularly important in obtaining more adequate information on the seasonal distribution of labor used. Furthermore, the procedure facilitates the use of the task-function formulation of the problem and thus requires fewer cooperating farmers to provide information on a given number of equipment combinations.

Still another factor that should be considered before making a final selection of the method of attack is the method of selecting a sample. Typically, studies designed to obtain labor coefficients have used a selected sample, which means that the standard tests of significance and measures of reliability used in connection with the random sample are not applicable. But, it seems unlikely that a random sample or a stratified

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customary." However, he minimizes this criticism by indicating that it should be relatively easy to develop a correction factor for time-travel studies by comparing survey and time-studies on identical farms. The latter statement deserves further consideration. The two sources of under-estimation—speed up of movements and elimination of so-called "waste time," will affect both fixed and variable time (both the Y intercept and the regression coefficient if regression analysis is used). Hence, Scoville's correction factor would have to be determined for each of several herd sizes. Furthermore, to test the hypothesis that the correction factor is independent of equipment and work procedures, the correction factor would need to be determined for different equipments and procedures as well as for different herd sizes. Hence, it appears that determination of correction factors using survey methods essentially involves duplication of the work using time and travel methods.

random sample of farmers would include a high proportion of farmers who would be willing to observe carefully and record the time spent, daily or weekly, on specific tasks in caring for the dairy herd. Thus, three alternative methods of attacking the problem were considered: (1) use of the total labor model, single survey, random sample; (2) task-function model, multiple survey, random sample; (3) task function, mail-in record system, nonrandom sample.

The first two methods have the disadvantage of high cost and memory bias, but they do allow use of traditional test of significance and measures of reliability. The first involves high cost because a large number of farmers would need to be visited; the second because the farms would need to be visited several times. The third system would cost less, minimize problems of memory bias, and facilitate the obtaining of information on seasonal distribution of labor, but it would not permit the use of significance tests. Both the second and third methods would facilitate the task-function approach and hence allow a smaller sample. Both would tend also to minimize possibilities of memory bias, although not to the same extent.

The mail-in method was utilized in this project because of 1) the limited funds available for the study and 2) the availability of a clientele consisting of members of the Southeast and Southwest Minnesota Farm Management Associations who, through years of cooperation with research and extension workers, have become accustomed to keeping rather detailed records of their farm business. Furthermore, over the years these farmers have been made aware of the need for accuracy if the information obtained is to be used for research purposes. It was recognized that in a strict sense, the use of a selected sample would not permit the use of the traditional tests of significance. Nevertheless, the authors believe that the gain in accuracy of information obtained, particularly in regard to memory bias, and the savings in costs of the study justified the use of this method. Standard statistics such as variance of the mean and variance of the regression coefficient were calculated, however, because they indicate the variability of the data. Furthermore, the standard tests of significance relative to regressions and adjusted means were performed. Although these tests were not strictly applicable with a nonrandom sample, they served as useful guides in interpreting the meaningfulness of the results. It is recognized that because of the nature of the sample, the data obtained did not represent truly all dairy farmers in the area. However, it is believed that these data provide a basis for making meaningful comparisons between alternative sizes of herds and combinations of equipment.

The "mail-in" record-keeping system was inaugurated in April 1956 and continued until April 1957. Approximately 100 farmers participated.

Method of Analysis

Different methods of performing each task were isolated by identifying usual combinations of such qualitative variables as kinds of equipment, work procedures, and barn arrangements. For each method, a functional relationship between labor used and the number of animals cared for was estimated by use of regression analysis. Analysis of covariance was used to test the significance of differences in labor used between methods.

There were, of course, several problems concerning the appropriate form of the data to be used for these calculations. The production period could be considered as a day, week, month, or season. Consequently, an analysis of the milking task for a seven month winter season might consist of estimating 210, 30, or seven regression equations, or only one for each management system. Considering the difficulties of estimating large numbers of equations, only a month and a season were considered as alternative periods. Preliminary analysis of several tasks within a season revealed no significant difference between months in either the regressions or adjusted means. Hence, the season (either winter barn feeding or summer pasture feeding) was chosen as the production period and within a particular season, only one equation was estimated for each method of accomplishing a task.

A second decision to be made was on the definition of an observation. Several alternatives were available: 1) Data from each farm for each of the seven days recorded in each month, making a day the standard unit of time; 2) the aggregate of seven days on each farm in each month, making the week the standard unit of time; and 3) the average of weeks over all months within the season for each farm, also making the week the standard unit of time.

The criterion for choice among these alternatives was largely the independence of the observations. If, for example, factors other than those taken into account in the analysis affected the labor used on a particular farm each day for which information was obtained, correlation between residuals would be expected. This problem might arise if either of the first two alternatives were used. In regard to the third alternative, it is clear that 20 farms observed seven times does not constitute 140 independent observations. Yet 20 farms observed seven times should provide more information than 20 farms observed once. As one of the major purposes of the study was to determine the effect of equipment on the labor used in caring for a dairy herd, comparisons were made among functions. One function might be for a practice that is relatively unmechanized and low in cost; another for one that is relatively mechanized and higher in cost. One would want to avoid recommending the latter method unless there was a real difference in the amount of labor used. To minimize the chance of

this kind of error in evaluation, it is necessary to choose an observation unit that minimizes the degrees of freedom used for the denominator in the calculation of F. This could be done by counting 20 farms observed seven times as 20 observations rather than 140 observations. For this and other reasons, and because preliminary investigation revealed no significant difference among weeks within a season, the third definition of an observation was chosen. Thus, an observation consists of the data from one farmer for the entire barn-feeding or pasture-feeding season.

Finally, an observation in an analysis of, say, milking time for a specific combination of equipment, barn arrangement, work procedures, and season was defined such that the regression equations fitted to these observations express the relationship between the total amount of labor used for milking in an average week and the number of cows actually milked in that week. Earlier work, using time and travel methods,[3] indicated that the nature of any particular task involved a certain amount of fixed time plus a constant amount of time for each additional animal. Obviously, this suggests a linear total labor function and a continually declining average amount of labor per cow. To check the hypothesis that after a certain herd size has been reached the average labor per cow increases, a second degree equation was also fitted to the data. In no case did this result in a significant reduction of the unexplained variance.

Even though a random sample was not used in this study, standard statistics were computed and tests of significance were performed. Although significance tests were the principal criteria for judging the meaningfulness of the results, other criteria were also used. For example, such criteria as magnitude or economic significance, internal consistency and synthetic functions developed from previous time and travel studies were helpful in reaching decisions about the nature of the equations.[4]

Results

The results of the analyses are shown in Tables 1 and 2. Behind these results were a number of decisions which, together with some descriptive comments, can only be summarized here. The barn arrangement (rows arranged lengthwise vs. rows across) was not found to affect the use of labor significantly. This was true of all tasks.

Since second degree equations did not provide a significant reduction in the unexplained variation, linear equations were used as estimating devices. The range of the data varies somewhat from one function to an-

[3] See Howard W. Ottoson, "Effect of Dairy Barn Arrangements on Chore Labor Requirements," unpublished Masters thesis, University of Minnesota, June 1950.

[4] See H. J. Aune, "An Economic Analysis of Labor Inputs in Dairying as Affected by size of Herd and Types of Equipment," unpublished Ph.D. thesis, University of Minnesota, June 1958.

TABLE 1. SUMMARY OF INDIVIDUAL ESTIMATING DEVICES AND SUPPLEMENTARY INFORMATION, WINTER SEASON

Method No.	Task and Description of Method	N	a Value or Mean	σ_a[1]	b Value	σ_b	$\sigma^2_{y\cdot x}$[2]	$\bar{X}$	Σx^2	r_a[2]
	Milking		(hrs.)		(hrs.)					
(1)	2 single units, 1 worker	33	0.65	1.7070	0.8119	.0871	8.29	18.74	1093.9388	.73
(2)	3 single units, 1 worker	13	−1.06	4.5207	.7237	.1763	15.1573	24.90	487.6200	.61
	Cleaning and preparation of utensils									
(3)	2 single units, mfg. milk, cans	27	3.62	*	*	*	1.3139	18.01	892.1667	*
(4)	2 single units, Grade A milk, either cans or bulk tank	23	5.13	*	*	*	1.9504	20.36	424.2165	*
(5)	3 single units, mfg. milk, cans	10	4.42	*	*	*	1.5862	25.02	329.7560	*
(6)	3 single units, Grade A milk, bulk tank	6	5.95	*	*	*	.2750	30.97	39.0333	*
	Hay feeding									
(10)	Baled hay, fed once a day	14	.88	1.0614	.0355	.0173	.3782	26.14	235.0343	.09
(11)	Baled hay, fed twice a day	34	1.47	.4875	.0355	.0173	.5013	25.67	1481.3662	.03
	Silage feeding									
(12)	Mechanically unloaded with cart	7	.77	.9350	.0617	.0166	.2450	29.83	259.7743	.40
(13)	Manually unloaded with cart	17	1.40	.4736	.0617	.0166	.2006	28.29	755.5094	.49
	Grain feeding									
(14)	Fed once a day	13	.43	.3035	.0383	.0109	.0664	25.09	481.5492	.51
(15)	Fed twice a day	52	.09	.3190	.0383	.0109	.3648	25.50	2504.1192	.14
	Manure handling									
(16)	Gutter cleaner	27	2.26	1.0970	.0629	.0361	.9422	29.92	721.8607	.07
(17)	Drive-through or litter carrier	21	2.81	1.2018	.1235	.0490	1.6764	23.86	699.3500	.21
	Bedding									
(19)	Baled and chopped	59	1.08	.3575	.0289	.0131	.4598	26.42	2673.1314	.06
(20)	*Other routine work*	73	.55	.3999	.0552	.0306	.6899	27.11	3369.7378	.16
(21)	*Care of dairy cattle not in stanchions*	56	2.80	1.0601	.1828	.0451	9.3820	21.68	4611.1343	.19
	Miscellaneous labor									
(23)	Dairy cattle in stanchions	39	.96	*	*	*	.6217	28.59	1305.7190	*
(24)	Dairy cattle not in stanchions	26	.18	*	*	*	.0274	21.90	1834.2800	*

[1] From the formula:

$$\sigma_a = \sqrt{\sigma^2_{y\cdot x}\left[\frac{1}{N} + \frac{\bar{X}^2}{\Sigma x^2}\right]}$$

Source: Carl A. Bennett and Norman L. Franklin, *Statistical Analysis in Chemistry and the Chemical Industry*, John Wiley and Sons, Inc., New York, 1954, p. 230.

[2] For those methods in which the mean is used, the value for σ_y^2 is entered in this column.

* These values were not entered for those methods in which the mean was used.

Irregular jobs

45—opening silo (each silo) Mean 2.17, $\sigma_y^2 = 1.1367$

46—feed grinding (hours per ton) 1.24, $\sigma_y^2 = .2230$. These figures used for both summer and winter seasons.

other, but generally it is from 10 to 40 animals. The use of additional workers per milking unit, either two men with three single units, or some extra help with two single units, increased the number of man-hours per cow milked; however, the data from this study did not provide reliable estimates of the magnitude of the additional labor. Since the equations for two single units were based on a much larger number of observations, they are considered more reliable than those for three single units.

The labor for the cleaning of utensils included the time spent washing and rinsing the milking units, milk cans or coolers, and the assembly of the milking units preparatory to milking. On the farms studied, all hay was stored overhead in the barn. The feeding of chopped hay required more labor than baled hay. Although there was some evidence that silage carts save labor the data did not provide reliable estimates of the saving. There was no significant difference between the labor used with and that

TABLE 2. SUMMARY OF INDIVIDUAL ESTIMATING DEVICES AND SUPPLEMENTARY INFORMATION, SUMMER AND SUPPLEMENTAL SEASONS

Method No.	Task and Description of Method	N	a Value or Mean	σ_a[1]	b Value	σ_b	$\sigma^2_{y \cdot x}$[2]	$\bar{X}$	Σx^2	r_{xy}^2
	Milking		(hrs.)		(hrs.)					
(1)	2 units, 1 worker	28	2.28	1.8214	.6520	.1054	4.8255	16.87	389.1571	.58
(2)	3 units, 1 worker,	14	−2.99	3.8932	.7348	.1533	13.0786	24.57	556.4486	.63
	Cleaning and preparation of utensils									
(3)	2 units, mfg. milk, cans	23	3.72	*	*	*	1.4481	16.26	259.7365	*
(4)	2 units, Grade A, cans or bulk tank	17	4.37	*	*	*	.8210	18.65	273.3424	*
(5)	3 units, mfg. milk ,cans	10	4.32	*	*	*	1.3973	24.99	392.4490	*
(6)	3 units, Grade A bulk tank	5	5.46	*	*	*	.1980	29.32	43.2480	*
	Hay feeding (Summer season)									
(7)	Baled hay, fed inside	8	1.39	*	*	*	.3670	21.81	144.1488	*
(8)	Baled hay, fed outside	15	.85	*	*	*	.2920	25.18	504.5973	*
	Hay feeding (Supplemental season)									
(9)	Baled hay, fed outside	15	1.41	*	*	*	.5535	25.20	799.9000	*
(10)	Baled hay, fed inside once a day	8	1.06	*	*	*	.5541	21.88	290.8750	*
(11)	Baled hay, fed inside twice a day	7	2.59	*	*	*	.8814	23.64	127.3571	*
	Grain feeding									
(14)	Fed once a day	9	1.06	*	*	*	.0978	21.78	718.5956	*
(15)	Fed twice a day	55	1.72	*	*	*	.3661	23.16	2045.9720	*
	Manure handling									
(16)	Gutter cleaner	28	1.63	*	*	*	.7723	26.48	770.1325	*
(17)	Drive-through or litter carrier—Grade A producers	11	1.84	*	*	*	1.4655	23.34	280.9654	*
(18)	Drive-through or litter carrier—mfg. milk producers	20	1.05	*	*	*	.3353	19.46	227.6095	*
(19)	*Bedding*	20	−.19	.6349	.0496	.0251	.3488	24.53	544.2375	.13
(20)	*Other routine work*	69	2.82	*	*	*	1.5688	24.97	3669.3261	x
	Care of dairy cattle not in stanchions									
(21)	Pens only	16	−.16	1.9776	.3670	.1575	7.7155	11.76	311.1994	.23
(22)	Pastured separately only	13	.48	.7338	.0669	.0251	.9708	26.35	1453.3323	.34
	Miscellaneous labor									
(23)	Dairy cattle in stanchions	27	.62	*	*	*	.1415	25.52	903.3467	*
(24)	Dairy cattle not in stanchions	21	−.08	.1043	.0123	.0057	.0430	24.46	1315.5019	.22
(25)	Daily rotational grazing	17	1.55	*	*	*	.1739	31.42	1304.9106	*

[1] From the formula:

$$\sigma_a = \sqrt{\sigma^2_{y \cdot x}\left[\frac{1}{N} + \frac{\bar{X}^2}{\Sigma x^2}\right]}$$

Source: Carl A. Bennett and Norman L. Franklin, *Statistical Analysis in Chemistry and the Chemical Industry*, John Wiley and Sons, Inc., New York, 1954, p. 230.

[2] For those methods in which the mean is used, the value for σ_y^2 is entered in this column.

* These values were not entered for those methods in which the mean was used.

used without a feed cart, but more of the farmers with larger herds tended to use a feed cart. The barn-cleaning equations include the time needed to clean the barn and to spread the manure in the field. In all instances, the manure was taken directly to the field rather than piled and spread at a later date. There was no significant difference between the amount of labor used with a litter carrier and with a drive-through arrangement. During the summer, Grade A producers used more labor because the barn had to be cleaned daily.

The other routine work category includes a number of jobs but consists primarily of turning cows in and out of the barn. Miscellaneous labor includes a number of nondaily jobs, such as spraying for flies, but consists primarily of caring for sick animals. The care of other dairy cattle not in stanchions includes labor for all tasks: feeding hay, silage, grain, milk, cleaning pens, etc.

Perhaps the most striking observation from the data is the large number

of tasks for which no significant relation was found between labor used and number of animals. This is particularly true of the summer season. Clearly, however, there were economies in use of labor as the size of the dairy operation was expanded. Because linear functions were used to estimate the labor used, labor economies can arise from 1) at least one regression coefficient in an aggregate equal to zero or 2) at least one equation in an aggregate with a positive y intercept. The first condition holds for six equations in Table 1 and for 17 equations in Table 2. In addition, the value of a is significantly greater than zero for equations 11, 13, 15, 16, 17, 19, and 21 of Table 1.

The equation for each of the tasks is expressed in terms of the number of animals involved in that particular task. Therefore, knowledge of the composition (e.g. 20 cows in milk, 22 cows fed hay, 20 head of young stock cared for, etc.) of the dairy herd is required before the task functions can be aggregated into a herd function for a month, season or year. As an example, the chore routine and average composition of herds in this study can be used in making estimates of a herd labor function.

The amount of labor used in milking in an average week during the winter can be predicted with equation 1:$L=0.65+0.8119$ (.89X) in which X is now the number of cows in the herd. To predict the amount of labor used in milking for a 29-week winter season, multiply this equa-

TABLE 3. CHORE ROUTINE AND PROPORTION OF ANIMALS ON WHICH EACH TASK IS PERFORMED FOR DAIRY HERD

Item	Proportion of animals involved in each task expressed as percentage of cows in herd		
	Winter	Summer	Supplemental[3]
Animals in stanchions[1]	per cent	per cent	per cent
Milking	89	84	—
Hay feeding	107	98[2]	98[2]
Silage feeding	105	—	—
Grain feeding	103	95	—
Manure disposal	107	98	—
Bedding	107	98	—
Miscellaneous	107	100	—
Animals not in stanchions			
Summer: pens only	—	52	—
Pastured separately	—	101	—
Winter:all groups	92	—	—
Miscellaneous	92	100	—
Other routine work	111	103	—

[1] When number of animals exceeds 100 per cent, animals other than cows in milk were occupying stanchions.

[2] Ninety-eight per cent of the cows in the herd were fed hay if any hay was fed. The more usual case was that no hay was fed in summer.

[3] The supplemental season refers to the latter part of the summer, when pastures were supplemented with the feeding of hay.

tion by 29. By making similar calculations for other tasks and taking the sum of these functions, a herd function can be developed for the winter season. Following a similar procedure, a herd function for the summer season can be developed. Summing the winter and summer functions results in an annual function given 1) the equipment and procedures 2) the structure of the herd and 3) the length of the pasture and barn feeding seasons. Several seasonal and annual functions are presented in Table 4.

TABLE 4. ESTIMATES OF LABOR USED FOR VARIOUS HERD SIZES, WORK PROCEDURES AND EQUIPMENT*

Method and Equation No.	Herd Size			
	10	20	30	40
Winter	hours	hours	hours	hours
(1) 1, 3, 11, 12, 15, 16, 19, 20, 21, 23, 24, 45, 46	802.48 (146.53)	1158.23 (141.04)	1513.97 (142.42)	1869.71 (150.33)
(2) Same as (1) except 2 and 5 replace 1 and 3	727.23 (185.03)	1060.21 (167.27)	1393.18 (163.51)	1726.16 (174.79)
(3) Same as (1) except 10 replaces 11	799.29 (146.79)	1155.04 (140.80)	1510.78 (142.43)	1866.52 (150.99)
(4) Same as (1) except 14 replaces 15	786.24 (145.37)	1141.99 (140.14)	1497.73 (141.53)	1853.47 (149.48)
(5) Same as (2) except 17 replaces 16	761.97 (186.56)	1113.74 (180.33)	1465.51 (165.90)	1817.28 (178.18)
(6) Same as (2) except 10 replaces 11	710.12 (185.46)	1043.10 (167.07)	1376.07 (163.34)	1709.05 (175.36)
(7) Same as (2) except 14 replaces 15	710.99 (184.34)	1043.97 (166.51)	1376.94 (162.74)	1709.92 (174.07)
(8) Same as (1) except 4 replaces 3	846.27 (148.06)	1202.02 (142.93)	1557.76 (144.29)	1913.50 (152.10)
Summer				
(9) 1, 3, 9, 15, 16, 19, 20, 21, 23, 24, 25, 46	508.26 (100.68)	697.71 (96.62)	887.16 (99.60)	1076.61 (110.16)

* The figure in parenthesis is $\sigma_{\hat{y}i}$, the standard error of individual estimates, where the variance of an individual estimate, $\sigma^2_{\hat{y}i}$, of the labor used for the entire year, is the sum of the variances of individual estimates for the summer and winter seasons. In turn, the variance of an individual estimate of labor used for a season is the sum of the variances for each task. The variance of an individual estimate for each task in a 29 week winter season is:

$$[29^2]\left[\sigma_{y\cdot x}{}^2 + \sigma_{y\cdot x}{}^2\left(\frac{1}{N} + \frac{(x_o - \bar{x})^2}{\sum x^2}\right)\right]$$

where: x_o is equal to the number of animals actually involved in the task in an average week. x_o is then equal to the number of cows in the herd multiplied by the correction factor shown in Table 3. For example, with a 20 cow herd, 89 per cent of which are milking, x_o is equal to 17.8 animals.

TABLE 4. (*Continued*)

Method and Equation No.	Herd Size			
	10	20	30	40
(10) Same as (9) except 2 and 5 replace 1 and 3	416.84 (134.89)	622.27 (122.92)	827.71 (120.56)	1033.14 (161.91)
(11) Same as (9) except 8 replaces 25	497.76 (101.80)	687.21 (96.75)	876.66 (99.73)	1066.11 (110.28)
(12) Same as (9) except 14 replaces 15	493.08 (100.97)	682.53 (95.88)	871.98 (98.89)	1061.43 (109.52)
(13) Same as (10) except 18 replaces 16	403.50 (134.04)	608.93 (121.98)	814.37 (105.50)	1019.80 (127.62)
(14) Same as (10) except 8 replaces 25	406.34 (134.99)	611.77 (123.03)	817.21 (120.67)	1022.64 (128.62)
(15) Same as (10) except 14 replaces 15	401.66 (134.37)	607.09 (122.34)	812.53 (119.98)	1017.96 (127.97)
(16) Same as (9) except 4 replaces 3	523.21 (100.02)	712.66 (94.89)	902.11 (97.92)	1091.56 (108.65)
Annual				
(17) (1)+(9)	1310.75 (178.35)	1855.94 (170.96)	2401.13 (173.80)	2946.32 (186.37)
(18) (2)+(10)	1144.07 (228.98)	1682.48 (207.58)	2220.89 (203.16)	2759.30 (238.26)
(19) (3)+(11)	1297.06 (178.63)	1842.25 (170.84)	2387.44 (173.87)	2932.63 (186.97)
(20) (4)+(12)	1279.33 (176.99)	1824.52 (169.80)	2369.71 (172.65)	2914.90 (185.31)
(21) (5)+(13)	1165.47 (229.72)	1722.67 (217.71)	2279.88 (196.61)	2837.08 (219.17)
(22) (6)+(14)	1116.46 (229.39)	1654.87 (207.48)	2193.28 (203.08)	2731.69 (217.48)
(23) (7)+(15)	1112.65 (228.11)	1651.06 (206.63)	2189.47 (202.19)	2727.88 (216.05)
(24) (8)+(16)	1369.48 (178.68)	1914.68 (171.56)	2459.87 (174.38)	3005.06 (186.91)

Summary and Evaluation

Perhaps the most important consideration in an evaluation of the results of this study, or the techniques and procedures used, is the size of standard error of individual estimates shown in Table 4. Unfortunately, there are so few publications of farm labor studies that include estimates of standard error that any comparison is virtually impossible. Nevertheless, a standard error of estimate which in some cases approximates 19 per cent of the expected value for the 10-cow herd and nearly 8 per cent for

the 40-cow herd may be considered large. Part of the considerable variability indicated by this statistic may be due to difference in the speed of the worker and thus inherent in any estimate of labor used in which the speed of the worker is not controlled.[5] Part of the variability may be due to the method of data collection. For some herd sizes, tasks such as grain or hay feeding require only 10 or 15 minutes per day. Clearly any tendency of the farmer to record the labor used for these tasks in terms of five minute intervals would represent a large percentage error. It is the judgment of the authors that for these tasks the recording error associated with the methods of data collection used in this study is of greater importance than the "speed-up" error associated with stop watch timing procedures. Hence, stop watch methods would be more appropriate for tasks requiring only a few minutes per day and would reduce the standard error of the estimates.

Another source of error may have resulted from the failure to obtain information on quantities of feed fed during each season of the year. It is conceivable at least that differences in quantities fed per cow may have contributed to the unexplained variance of equations for feeding hay, grain and silage.

Though the standard errors of individual estimates are large, it should be noted that they would have been still larger if, like the usual farm labor study, no attempt had been made to remove components due to differences in equipment, type of products, herd composition and herd size. However, if the standard error is considered large as suggested by the results of this study, there are some serious questions about the usefulness of applications to individual farm situations of results of linear programming studies that are based on coefficients with single valued expectations.

Aside from the size of the standard error, the results of this study raise additional questions about the value of many budgeting and linear programming studies involving the dairy enterprise. These results indicate that more attention should be given to the type of product produced and the equipment or work procedures used. For a 20-cow herd, using line 24 of Table 4, the average labor per cow is 96 hours as contrasted with 83 hours per cow using line 23. In any case in which the labor available is in fact a limiting factor in the final solution, such a difference in the labor coefficients might not only change the magnitude of the dairy enterprise but also change the enterprises included in the final solution.

[5] It is interesting to note, however, that the evidence gathered in this study indicates that "fast workers" and "slow workers" can be identified only for particular tasks. The speed with which the individual performed one task, as measured by the positive or negative deviation from the regression equation, had no readily discernible relation to the speed with which he performed other tasks.

A more important consideration in the usual linear programming study however, is the economy in use of labor as the size of the dairy herd increases. For example, when line 17 of Table 4 is used, the average amount of labor used per cow is 131 hours per 10-cow herd as compared with 93 hours per cow for the 20-cow herd. Thus, use of a constant labor coefficient—100 hours per cow, for example—in budgeting and linear programming studies could introduce a considerable error into the analysis.

Even though the average labor per cow does decline continually over the range of the observations, the results for any particular combination of equipment, herd composition and type of product can be readily incorporated into the usual linear programming study. This can be done because the total labor equations are linear. One method would involve comparing two solutions. One solution would be determined with some minimum size of dairy herd and a constant labor coefficient (e.g. 54.5 hours per cow, line 24, Table 4) for all dairy cows above the minimum number. The other solution would omit the possibility of a dairy enterprise.

The use of the task function formulation facilitates a wide range of uses of the results obtained. They can be combined into a variety of aggregates to provide estimates of labor used for many types of production situations. These results can be readily supplemented with information on other equipment and procedures. With some revision in methods of data collection particularly the use of stop watch timing methods for some tasks, more adequate information on labor coefficients could be obtained.

HOW MUCH HAS THE CANADIAN WHEAT BOARD COST THE CANADIAN FARMERS?

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SHOULD the American and Canadian price support policies for agriculture be modified to relieve the taxpayer and the farmer of the burden of losses due to the changes in the market price? Losses seem inherent in these programs where large volumes of grain are accumulated and held in storage for years and sold at prices sometimes no higher and sometimes even lower than the price at which they were acquired. To make an estimate of the monetary value of losses over an extended period, it is necessary to set up an analytical method of isolating and measuring the gains and losses involved.

This problem is of immediate concern to Canadian wheat producers since the farmers themselves, for the most part, bear the cost of the Canadian wheat program. In the United States, the taxpayer bears the cost of price support policies. In addition, production controls have been an integral part of the United States' program. Little or no control of production has been instituted in Canada.

Included below are a brief review of the historical events leading up to direct selling by Canadian farm organizations and their federal government; instances of the dominion government aid to wheat producers; evaluation of the effectiveness of the Canadian Wheat Board and the Wheat Pools as sales and speculative agencies; and finally, a discussion and evaluation of other possible benefits of the Canadian wheat selling policy.

The Rise of Farmer Speculation

In most national economies, nearly all grain crops are harvested over a short period of time. If these grains are to be utilized throughout the year, part of the volume of grain available must be held in storage while a smaller part of the total amount of grain flows into consumption. Storage stocks may be quite large soon after a new crop is harvested. Towards the end of the year, stocks tend to decrease and disappear completely when no year-end carry-over stocks are held. Someone must hold title to the stocks of grain until they are consumed. Unless the price of the grain is fixed and completely known for a long period into the future, speculation in grain is an economic function that must be undertaken by the economy. Someone must bear the risk of a price change from the time the grain becomes available until the grain is consumed. Someone must make the decisions as to when to hold the grain and when to move it into consumption. Holding the grain and selling the grain are but opposite sides

of the same coin. Hence, speculation cannot be divorced from sales policy which moves the grain into final consumption. The institutional arrangement by which grain moves into consumption may be quite complicated and may vary by commodity and country.

The Wheat Pools were organized in 1923 and 1924 under the impetus of addresses given by Aaron Sapiro, who stumped the Canadian West in 1923. The pools quickly developed to the point where they handled half the wheat produced on the Canadian prairies. The wheat from the three pools was funneled through a single agency, the Central Selling Agency for Marketing. The Wheat Pools sold unhedged wheat to overseas buyers directly through agencies established in importing countries. Pooling, as the name implies, involved also the averaging of returns so that all members delivering similar quality products received the same price. This was accomplished by giving the grower an initial payment well below the expected return on the wheat and then remitting interim payments until all the money received from selling the wheat was returned to the farmer.

Orderly Selling, which was never precisely defined, was the slogan of the pools. At first they sold their grain for the most part within the crop year and hence engaged only in intra-crop-year speculation. However, pressure soon developed from the more liberal pool members to gain and maintain better prices and hence led to speculation between crop years.[1] The conservative selling policy of Central Selling Agency no doubt contributed a great deal to the long life of the Canadian Wheat Pools. However, with the onset of the depression, the three prairie pools followed the path of the Sapiro cooperatives in the United States and they would have gone broke except for the intervention of the dominion government.

It became apparent in 1930 that the pool's initial payment for wheat delivered by farmers that fall could not be recovered by the returns from sales of the wheat overseas. The Canadian government took over the stocks of wheat held by the pools and placed the management of the Central Selling Agency under the direction of John I. MacFarland, who was directly-responsible to the dominion Cabinet. The direct marketing of wheat was replaced by stabilization operations through the medium of the Winnipeg Grain Exchange. In 1935 the Canadian Wheat Board was established and provided an alternative channel to the Winnipeg Grain Exchange for the marketing of Canadian wheat. When the price of wheat on the Winnipeg Grain Exchange was higher than the minimum price for

[1] V. C. Fowke, *The National Policy and the Wheat Economy*, Toronto: University of Toronto Press, 1957, pp. 230-247. H. A. Innis, *The Diary of Alexander James McPhail*, Toronto: University of Toronto Press, 1940. Conservative sales policies as used in these two writings refer to within crop year speculation. A liberal sales policy refers to speculation with large storage stocks and between crop years and the larger the carry-over the more liberal would be the policy.

wheat delivered to the Wheat Board, the wheat producers sold most of their wheat to the private elevator companies. When the price on the open market was lower, the farmers delivered most of their wheat to the Wheat Board. In 1943 the Wheat Board was given a monopoly of sales of Canadian wheat. Futures trading in Canadian wheat on the Winnipeg Grain Exchange ceased in 1943 and has not been resumed.

From 1929 on, therefore, the large stocks of Canadian wheat were attributable, for the most part, to the farmers' organization or to agencies of the federal government which had the approval of the Canadian wheat grower. The risk of a price change was borne almost exclusively by the Canadian farmer who had contributed to the wheat stocks under the control of the Canadian Wheat Pools and the Canadian Wheat Board. The farmer received the net proceeds from the sale of Canadian wheat after all the expenses of selling had been paid.

Government Assistance to Wheat Growers

Other activities by the government or farm organization may have been more important and may have contributed so much to the welfare of the farmer that any loss through an inept sales policy may be unimportant. A look at the record will indicate that the other policies (i.e., other than the sales policy) could have been carried out without interfering with the sales policy. These other programs did not affect incomes to the same extent as did the federal sales policy.

The loss to the federal government on export sales when the Wheat Board failed to realize the minimum price set for deliveries to the Wheat Board has been estimated at 48 million for the period 1938-39.[2] The federal government paid a bonus to the farmers to offset the low price at which wheat was sold to Great Britain under the British Wheat Agreement signed in 1946. In 1943 the federal government made a payment to wheat producers of 75 cents per acre on half the cultivated acreage. This was done to offset marketing restrictions and the acreage reduction program.

Payments were made to wheat producers in 1941 and 1942 and 1943 for reducing wheat acreage. These amounted to $82,000,000.

None of these policy measures indicates that the Canadian storage program was incidental to a larger measure which tended to increase farm income. Rather, the Canadian policy seemed to be one of price support without any regard as to how this price support policy affected the final proceeds from the sale of the crop. The final outcome of such a policy rests anomalously on the speculative returns of its storage program. A

[2] D. A. MacGibbon, *The Canadian Grain Trade, 1931-1951*. Toronto: Toronto University Press, 1951.

price support policy and speculation are not completely divergent since both accumulate stocks when prices are low and reduce these stocks when prices are high. However, because of political pressures, the speculative phase of the policy may be ignored so that the policy instead of bolstering wheat producers' income may actually reduce it.

The Speculative Returns of the Storage Program

Since the returns of speculators is the difference between buying and selling price, the total returns to speculators can be written as:

$$R = S[p_2 - p_1]$$

where p_1 is the price at which the grain is purchased, p_2 is the price at which the grain is sold, S is the total number of bushels of grain carried over from one period to the next and R is the total returns. Speculators are motivated in their storage decisions by their anticipation as to what the price will be in the second time period. When the storage stocks are accumulated, they know only the price (i.e., p_1) in the present time period. Hence, speculators must form rational expectation as to p_2, the price in the next time period. The net returns from storage must take into consideration the cost of holding unused stocks of grain and can be represented as:

$$NR = S[p_2 - p_1 - c]$$

where c is the cost of holding a bushel of grain from one year to the next and NR is the net returns from storage operations. Whether we are considering the economy as a whole or speculators such as the Wheat Pools or the Canadian Wheat Board, the quantity of stocks accumulated will affect both p_1 and p_2, the present and future prices. Hence, this factor must be taken into consideration when decisions are being made as to the quantity of grain to be stored. Suppose the demand for Canadian wheat is a linear function which can be represented as:

$$p = a - bq + dD$$

where p is the price, q is the quantity of Canadian wheat and D represents factors which shift the demand curve. Factors which shift the demand curve for Canadian wheat are production in other commercial wheat areas of the world, income in the consuming areas, and changes in tastes and consuming habits over time. Commercial policies of importing nations also would have an effect on the demand for Canadian wheat. The term dD can be embodied in the constant term of the demand curve on the assumption that the quantity of wheat supplied by Canadians does not shift the demand curve for Canadian wheat. The constant term is given a subscript to indicate that its value shifts from one time period to the next. The demand curve is assumed stable for each time period.

The world wheat crop is the most important demand shifter. Thus, the net returns function for storage can be written as:

$$\begin{aligned} NR &= S\{[a_2 - b(H_2 + S)] - [a_1 - b(q_1 - S)] - c\} \\ &= S[a_2 - bH_2 - bS - a_1 + bq_1 - bS - c] \\ &= S[a_2 - bH_2 - a_1 + bq_1 - 2bS - c] \end{aligned}$$

where q_1 is the quantity of grain available in the first time period before storage takes place and H_2 is the size of the crop in the second time period. The slope of the demand curve is important in storage returns since, for the economy as a whole, the net returns are reduced by the factor $2bS^2$. This is because of the fact that when stocks, S, are acquired, the price and hence the cost are raised by the amount bS per bushel. When the stocks of grain S are sold, the price and hence the returns are reduced by the same amount, namely bS per bushel. The greater the absolute value of b (i.e., the more inelastic the demand for a constant elasticity demand curve), the less private speculators storing grain to take advantage of an expected change in price would store. The more inelastic the demand, the smaller the volume of stocks required to stabilize the price.

Listed below are equations involving price, storage and harvests which may be useful in analyzing storage programs.

A. *The Observed Market Price*

Let p_1 and p_2 represent the price that was actually observed in the market. Then expressed in the form of demand curves, one has:

$$p_1 = a_1 - bH_1 - bS_0 + bS_1$$

$$p_2 = a_2 - bH_2 - bS_1 + bS_2$$

where p_1 is the price in year one, H_1 is the harvest at the beginning of year one, S_0 represents the carry-over stocks carried out of year zero into year one, and S_1 is the carry-over stock carried out of year one. Since this is the observed price, carry-over stocks in any year may actually be zero. The constant term a_1 is given a subscript to show that the demand curve may shift from year to year.

B. *The Market Price with Year End Carry-over Stocks Adjusted to Zero*

Let p'_1 and p'_2 represent the market price adjusted to show the price that would have prevailed if carry-over stocks had been zero. Hence:

$$p_1' = a_1 - bH_1 - bS_0$$

$$p_2' = a_2 - bH_2 - bS_1$$

All the grain harvested and carried into the crop year is consumed. It is

possible for the p′ price to be the observed market price for the same years but it is best regarded as an adjusted price.

C. *The Price If Only the Harvest Is Sold*

Let p″ represent the price that would have occurred in the market if both the carry-in stocks and carry-over stocks had been zero.

$$p_1'' = a_1 - bH_1$$

$$p_2'' = a_2 - bH_2$$

This again is an adjusted price. There may, of course, be years in which no carry-in or carry-over occurred. Under these conditions p and p″ would be equivalent.

Given the slope of the demand curve (i.e., the value of $-b$), the two adjusted prices p′ and p″ can be obtained from the observed market price. Thus, for year one one writes:

$$p_1' = p_1 - bS_1$$

and

$$p_1'' = p_1 + bS_0 - bS_1$$

These relationships are important for analysis of speculative losses or profits since only p is observed in the markets.

When one develops the returns to speculators, a two year horizon is used first. This presupposes that all the carry-over stocks accumulated in the first year are all sold in the second. This is the condition private speculators like—a low price in the first year and a high price in the second. Speculators tend to accumulate carry-over stocks when prices are low. However, the price in the following year is not always to their liking. Government storage is not predicated to the same goals as that of private speculators, but speculative returns from their operations rest on the same basis. If all the stocks carried into the second year are sold in the second year, the price in the second time period would be:

$$p_2' = a_2 - bH_2 - bS_1$$

which is equal to:

$$p_2 - bS_2 = a_2 - bH_2 - bS_1 + bS_2 - bS_2.$$

The price in the market when the S_1 stocks were acquired would be:

$$p_1 = a_1 - bH_1 - bS_0 + bS_1$$

The total returns to storage for this two year horizon is:

$$R_1 = S_1[p_2' - p_1] = S_1[p_2 - bS_2 - p_1]$$

$$= S_1[p_2 - p_1] - bS_1S_2$$

$$= S_1[(a_2 - bH_2 - bS_1 + bS_2) - (a_1 - bH_1 - bS_0 + bS_1)] - bS_1S_2.$$

Should stocks be acquired in the second year for carry-over into the next

crop year, the price in the second year would be raised by the amount bS_2. The returns for this situation would be:

$$R_2 = S_2[p_3 - p_2] - bS_2S_3$$
$$= S_2[(a_3 - bH_3 - bS_2 + bS_3) - (a_2 - bH_2 - bS_1 + bS_2)] - bS_2S_3$$

This indicates the potential returns to speculators had they been responsible for the accrued stocks one year at a time.

When one is considering a multiple year horizon, the total returns function for speculators for the economy as a whole is altered. The cost of acquiring stocks where stocks already exist is the alternative cost of holding (i.e., stocks can be shifted from one speculator to another at the market price). In any case, the cost of acquiring stocks that were held was the actual market price. The price realized on sales from storage stocks is also in this case the market price. The speculative returns from storage operations for the economy as a whole for any one year would still be:

$$R_1 = S_1[p_2 - p_1]$$

Summing these returns over a series of years will give the total speculative returns of all speculators in the economy. Where a single agency is involved, these speculative gains or losses can be charged to it.

Speculative Returns From the Canadian Program

The results of applying the longer period analysis to the Canadian storage program is given in Table 1. Total year-end carry-over stocks are assumed to contain 25 million bushels of pipeline stocks. Pipeline stocks in this case are required to assure continuity of utilization as the new crop moves into position. They are stocks that would be required irrespective of the size of the year-end carry-over to bridge the gap between the old and new crops. The estimate of 25 million bushels for pipeline stock at year-end was obtained from years in which it is obvious that the carry-over was very low. In two years, 1921 and 1938, the wheat stocks in Canada at the end of July were 23.1 and 23.4 million bushels, respectively. It would, therefore, appear that 25 million bushels would be an adequate reserve of pipeline stocks at the beginning of a new crop year.

If no storage costs are involved for the period 1929 to 1956 inclusive, the storage policy of Canadian wheat would have netted 265 million dollars. Charging 12 cents storage per bushel per year, gives one a loss of 399 million dollars. If storage costs are charged at 10 cents per bushel per year, the total loss is 298 million dollars. The Canadians held 102 million bushels of wheat at the end of the 1929 crop year which were never actually cleared out until the 1937 crop year. The price in 1937 was only half a cent higher than in 1929. Thus 102 million bushels were held for nine years. The loss on this transaction was the cost of storage.

These estimates are not exact. The prices used are average prices on the free world market for the crop year. Hence the actual price at which the stocks were sold need not have been the average price. The actual speculative loss may have been much greater or much lower than the estimates arrived at here. The purpose of making these estimates is not so much to arrive at losses which can be laid at the door of any agency,

TABLE 1. RETURNS TO STORAGE*

Year Ending July 31	Average Price for Crop Year (cents)	Year End Stocks Minus 25,000 (1,000 bu.)	Price Change (cents)	Price Change Minus 12 Cents Cost of Storage (cents)	Carry-Over Storage Multiplied by Change in Price (dollars)	Carry-Over Storage Times Change in Price Less 12 Cents Cost of Storage (dollars)
	p_i	S_i	$(p_{i+1}-p_i)$	$(p_{i+1}-p_i-c)$	$S_i(p_{i+1}-p_i)$	$S_i(p_{i+1}-p_i-c)$
1929	124.125	102,239	0.250	−11.750	255,597.50	− 12,013,082.50
1930	124.375	101,582	−60.125	−72.125	− 61,076,177.50	− 73,266,017.50
1931	64.250	113,598	− 4.375	−16.375	− 4,969,912.50	− 18,601,672.50
1932	59.875	100,941	− 5.625	−17.625	− 5,677,931.25	− 17,790,851.25
1933	54.250	192,657	13.875	1.875	26,731,158.75	3,612,318.75
1934	68.125	177,902	13.625	1.625	24,239,147.50	2,890,907.50
1935	81.750	188,852	2.875	− 9.125	5,429,495.00	− 17,232,745.00
1936	84.625	102,363	38.250	26.250	39,153,847.50	26,870,287.50
1937	122.750	12,049	8.875	− 3.125	1,069,348.75	− 376,531.25
1938	131.625	000	−69.625	−81.625	000.00	000.00
1939	62.000	77,911	14.500	2.500	11,297,095.00	1,947,775.00
1940	76.500	275,473	− 2.500	−14.500	− 6,886,825.00	− 39,943,585.00
1941	74.000	455,129	2.625	− 9.375	11,947,136.25	− 42,668,343.75
1942	76.625	398,752	18.125	6.125	72,273,800.00	24,423,560.00
1943	94.750	569,626	46.875	34.875	267,012,187.50	198,657,067.50
1944	141.625	331,531	6.125	− 5.875	20,306,273.75	19,477,446.25
1945	147.750	233,072	7.250	− 4.750	16,897,720.00	11,070,920.00
1946	155.000	48,600	89.250	77.250	43,375,500.00	37,543,500.00
1947	244.250	61,141	34.000	22.000	20,787,940.00	13,451,020.00
1948	278.250	52,710	−52.000	−64.000	− 27,409,200.00	− 33,734,400.00
1949	226.250	77,411	− 7.625	−19.625	5,902,588.75	− 15,191,908.75
1950	218.625	87,200	− 6.375	−18.375	− 5,559,000.00	− 16,023,000.00
1951	212.250	164,203	20.875	8.875	34,277,376.25	14,573,016.25
1952	233.125	192,178	−16.625	−28.625	− 31,949,592.50	− 55,010,952.50
1953	216.500	358,185	−30.125	−42.125	−107,903,231.25	−150,885,431.25
1954	186.375	576,675	−13.500	−25.500	− 77,851,125.00	−147,052,125.00
1955	172.875	474,748	1.000	−11.000	4,747,480.00	− 52,222,280.00
Total (positive returns)					+599,801,103.5	+323,969,452.4
Total (negative returns)					−335,185,583.6	−722,561,292.2
Total (net profits)					+264,615,519.9	−398,591,839.8

*Source of data on price and total carry-over, Stanford Evans Company, Limited, Winnipeg, Canada, *The Wheat Situation* (United States Department of Agriculture, Agricultural Marketing Service).

but rather the purpose is to show that speculative returns or losses are inseparable to the marketing of Canadian wheat and they are so substantial that they must be considered seriously.

That these losses were not the result of unlucky and adverse events for the marketing agencies can readily be shown. Several events may be construed as fortuitous in regard to the Canadian wheat storage program since they tended to ease the pressures on Canadian stocks. The crop failures of the thirties in both Canada and the United States slackened the build up of surplus stocks.

The Second World War and the period of high demand following it reduced stocks in Canada and the United States. The Korean War also raised wheat prices for a short period. Canadian wheat stocks have now reached their highest levels of all time. Sufficiently high wheat prices in the world market to yield speculative profits from these stocks does not seem to be a rational prediction. To say that the Canadian wheat program is now in trouble cannot be construed as an overstatement.

That speculative losses have been inherent in the Canadian wheat storage program has been shown. Now the question of whether or not these losses are real will be examined. These losses are real if no benefits to offset them can be found, and hence, had these operations not been undertaken, the wheat producers' incomes would have been increased.

The Price Elasticity for Canadian Wheat

Price elasticity has implications for storage policy. It will be useful to see what light can be thrown on demand elasticity at this point. A thorough study of price elasticity for Canadian wheat has not been undertaken to the author's knowledge. Contrary to Canadian beliefs in general, the evidence at hand indicates that the demand for this wheat is not highly inelastic if inelastic at all.

Theodore Yntema has derived a formula for the elasticity of a commodity in the export market which is useful as a benchmark from which to reason.[3] According to this formula, the price elasticity of the export demand for Canadian wheat can be expressed as:

$$N_c = \frac{q_d}{q_d - q_s} N - \frac{q_s}{q_d - q_s} e$$

where q_c is the quantity demanded in the importing countries, q_s is the quantity supplied from all other than Canadian sources to the importing countries, N is the elasticity of demand in the world market and e is the elasticity of supply from the producing nations. In the first term, the

[3] Theodore O. Yntema, *A Mathematical Reformulation of the General Theory of International Trade*, Chicago: University of Chicago Press, 1932.

elasticity of demand for world wheat is multiplied by the inverse of the proportion of world wheat supplied by Canadian sources. From this term is subtracted the elasticity of supply of wheat to the international market from sources other than Canada multiplied by the inverse of the proportion that Canadian supplies to the international market is of all other supplies in the world market. Thus, the smaller the percentage of Canadian wheat in the world market, the more elastic is the demand for Canadian wheat. Furthermore, since Canada is competing with areas less specialized in wheat production, this also tends to increase the elasticity.

In *The Demand and Price Structure for Wheat,* Kenneth W. Meinken estimates that the price flexibility of wheat in the world market for the interwar years was -1.43.[4] This is equivalent to a price elasticity of -0.70. American wheat at export would, therefore, be quite elastic if Yntema's formula is applied. On the same basis, since Canada tends to supply smaller quantities of wheat in the world market, the price elasticity for Canadian wheat would tend at times to be even higher. This is essentially a short run price elasticity estimate. If the elasticities of demand and supply based on the long run concepts introduced by Working were used, then the elasticity of demand for Canadian wheat at export may become quite elastic.[5]

Elasticity and Storage

It has already been noted that if the influence on price of withholding a bushel from or adding a bushel to consumption is large, then a smaller quantity needs to be stored to stabilize price than if the influence on price were small. Private storers hold smaller stocks when the demand is inelastic than they would if the demand were more elastic.

With an elastic demand a government storage program would have to store a great deal more grain to raise the price a given amount than would be required if the demand were inelastic. With quite elastic demand conditions a price support program can become quite burdensome.

Unless the price elasticity is less than unity, no short run benefits are obtained from a storage program unless the government guarantees this price to all producers and makes up the difference if the grain is sold for less. Raising price does not increase income from sales unless the demand is inelastic. Should the short run demand at export be elastic as indicated,

[4] Kenneth W. Meinken, *The Demand and Price Structure for Wheat,* Tech. Bul. 1136, U. S. Department of Agriculture, November 1955, p. 43.

[5] E. J. Working, *The Demand for Meat,* Chicago: University of Chicago Press, 1954. It is my understanding that Working is now setting forth the theoretical aspects of long run relationships and integrating his work with that of Nerlove. See Marc Nerlove, *The Dynamics of Supply,* Baltimore: The Johns Hopkins Press, 1958.

the Canadian storage program did not increase farmer incomes even in the years grain was held off the export market. Any claim to temporary benefits by the Canadians is therefore in serious jeopardy.

It is a necessary to consider one more relationship between elasticity and storage. This is in connection with the ever-normal granary approach.

Other Possible Gains From Operations of the Wheat Board

Canadians often make the statement that without the operations of the Wheat Board and price stabilization operations, the price of wheat would have been much lower. This is, no doubt, true of the years in which stocks were increased. It is not necessarily true of the over-all operations. Not only have the total returns to farmers been reduced by the speculative losses of the Wheat Pools and the Wheat Board, but the increase in price when stocks are increased is offset to some degree and perhaps more than offset by the decrease in price when the accumulated stocks are released. Hence, the price realized by farmers over a period of years may have been reduced by the operations of the Wheat Board and the Pools for a second reason. We need to take into account the effect of the change in price due to storage operations on the total returns from wheat sales.

If the demand curve for Canadian wheat is a straight line, then a rise in price due to the accumulation of stocks when the crop is large would increase income on Canadian farms more than would a similar decrease in price occurring when crops are small. This is illustrated in Figure 1. In this diagram p''_1 is the price that would have existed in the first year if only the harvest in that year had been marketed. p_1 is the price that would have ruled if stocks equal to S had been accumulated out of the H_1 harvest.[6] The change in price due to the accumulation of stocks is $p_1 - p''_1 = bS$. This is equal to $p''_2 - p_2 = bS$, the decrease in price when the stocks are released for consumption. The total decrease in price bS would have been the same if the total volume of stocks S had been released in two or more successive years.

Since in theory, stocks should be accumulated from large crops to be released in years when crops are small, farmers would benefit to some degree from storage if the demand curve for grain were linear. The increase in total revenue resulting from storing out of the large crop would be:

$$H_1[p_1 - p_1''] = H_1bS.$$

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[6] The price $p_1'' = a_1 - bH_1$ is in line with the previous notation. No price is delineated for $p_1 = a_1 - bH_1bH_1 + bS$. It could be written p_1'''. However, p_2 in Figure 1 is equal to $p_2' = a_2 - bH_2 - bS$ in the previous notation.

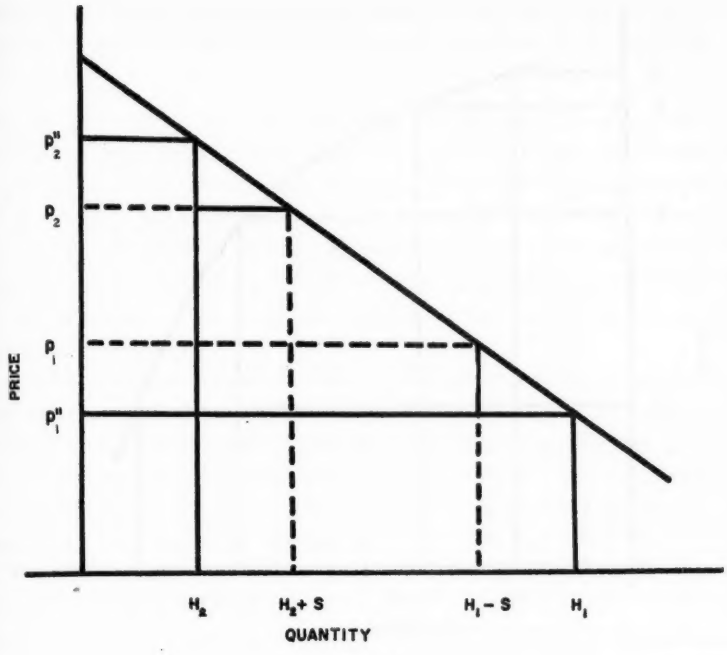

FIG. 1

The decrease in total revenue that occurs when these stocks are consumed would be:

$$H_2[p_2'' - p_2] = H_2bS.$$

Hence, the net effect on total revenue would be for a straight line demand curve:

$$[H_1 - H_2]bS.$$

If the demand curve is not linear, then the change in price when stocks are accumulated is not of the same magnitude as the change in price when stocks of the same magnitude are released for consumption. This follows from the fact that the slope or the steepness of the demand curve varies from point to point. Figure 2 indicates a demand curve in which the rise in price is greater when stocks are accumulated from a large crop than the decrease in price when these stocks are sold for consumption in competition with a small crop. In symbols one has $p_1 - p''_1 > p''_2 - p_2$. This demand curve shows more elasticity for small crops and greater inelasticity for large crops than a comparable straight line demand curve. Figure 3 is related in its shape to a constant elasticity demand curve. In this case, the effect on price $p''_2 - p_2$ of releasing stocks is greater than $p_1 - p''_1$, the price effect of accumulating them. If the demand curve is inelastic, then the effect of the size of the crops tends to

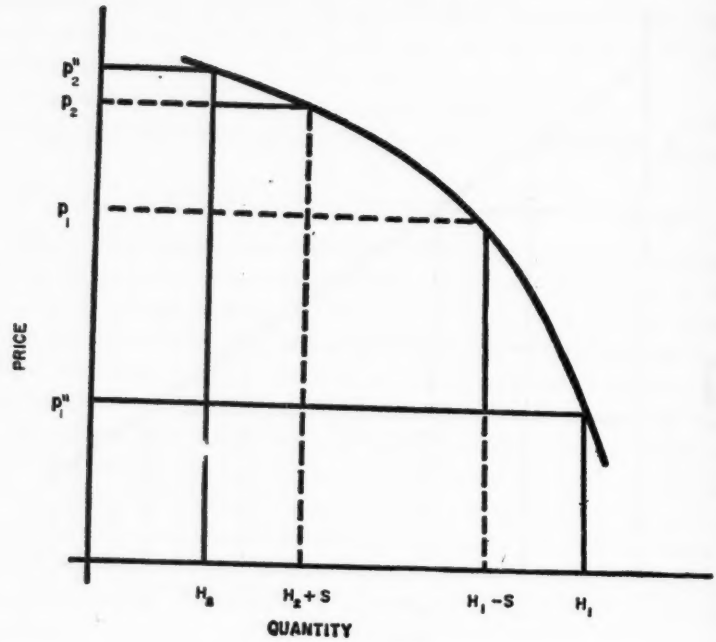
P''_2
P_2
P_1
P''_1
PRICE
H_2
H_2+S
H_1-S
H_1
QUANTITY

FIG. 2

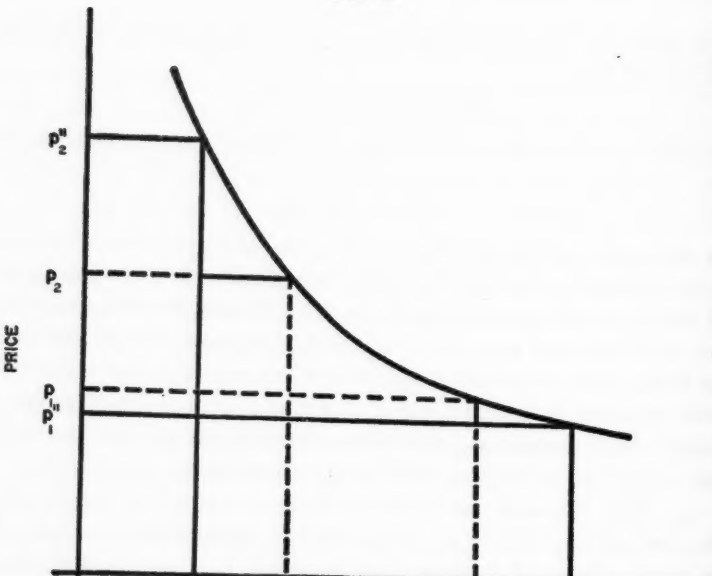
P''_2
P_2
P_1
P''_1
PRICE
H_2
H_2+S
H_1-S
H_1
QUANTITY

FIG. 3

be outweighted and storage actually tends to reduce total revenue from a series of crops. In symbols the following situation tends to arise:

$$H_1[p_1 - p_1''] < H_2[p_2'' - p_2]$$

Thus, two situations are outlined here. If the demand curve for wheat approaches a constant elasticity demand curve in shape and is inelastic, then a storage program of destabilization is called for. Such a program would store from small crops and unload stocks to increase consumption in years of large crops. This will increase the returns to producers. With all other demand curves, a stabilization storage program is called for which stores grain when crops are large and releases them for consumption when crops are short.[7]

On *a priori* grounds one tends to be uncomfortable with a destabilization storage program. This would be the antithesis of providing against years of scarcity.[8] Also a demand curve such as shown in Figure 2 likewise tends to be unacceptable. It seems somewhat more reasonable that the price and quantity axes should be approached more gradually (i.e., asymptotically) rather than an abrupt diminution in use when the price for the quantity has exceeded certain levels. Thus stabilization if profitable is not likely to be extremely so.[9]

Set up the hypothesis that stabilization will increase total revenue and then assess the Canadian program on this basis. If the Canadians increased the price by increasing stocks whenever the harvest was large and if they decreased the price by unloading stocks when the crop was small, then their actions were consistent with this hypothesis. Table 2 summarizes the analysis on a year to year basis. Whenever a large crop was followed by a small crop, the stocks held should have increased. Thus

[7] D. Gale Johnson, *Forward Price for Agriculture*, Chicago: University of Chicago Press, 1947, pp. 147-177. F. V. Waugh, *et al.*, "The Controlled Distribution of a Crop Among Independent Markets," *Quarterly Journal of Economics*, Vol. 51, November 1936, pp. 1-41. Mordecai Ezekiel, "A Statistical Examination of the Problem of Handling Annual Surpluses of Nonperishable Farm Products," *Journal of Farm Economics*, Vol. 11, April, 1929, pp. 193-226. F. V. Waugh, "Market Prorates and Social Welfare," *Journal of Farm Economics*, Vol. 20, May, 1938, pp. 402-416; "Benefit from Price Instability," *Quarterly Journal of Economics*, Vol. 57, August, 1944 ,pp. 602-14.

[8] A highly inelastic constant elasticity demand curve such as that in Figure 3 implies that as the quantity offered for sale becomes very small the price can be driven to infinity. Such commodities would be those necessary to sustain life; for instance, air, water, food in general and perhaps clothing in a cold climate. It is obvious that wheat is not one of these.

[9] An estimate of the benefits from the ever-normal granary for corn in the American economy using a straight line demand curve has been made. See Conrad Gislason, "The Storage of Grains with Special Reference to International Trade," Unpublished Ph.D. Thesis, University of Chicago, 1958. The increase in returns to farmers was very small, less than one-tenth of a cent per bushel if the storage program was carried to its optimum level in terms of the ever-normal granary model. This return per bushel was estimated as an increase over private storage levels.

TABLE 2. EVER-NORMAL GRANARY RETURNS FROM STORAGE

	H_t	$H_t - H_{t+1}$	$S_t - S_{t+1}$	Consistency with H_t
	(1,000,000 bushels)	(1,000,000 bushels)	(1,000 bushels)	
1929	302	−119	657	inconsistent
1930	421	100	− 12,016	inconsistent
1931	321	−122	12,657	inconsistent
1932	443	161	− 91,716	inconsistent
1933	282	6	14,755	consistent
1934	276	− 6	− 10,950	consistent
1935	282	63	86,489	consistent
1936	219	39	90,314	consistent
1937	180	−180	12,049	inconsistent
1938	360	−161	− 77,911	consistent
1939	521	− 19	−197,562	consistent
1940	540	225	−179,656	inconsistent
1941	315	−242	56,377	inconsistent
1942	557	273	−170,874	inconsistent
1943	284	−133	238,095	inconsistent
1944	417	99	98,459	consistent
1945	318	− 96	184,472	inconsistent
1946	414	72	− 12,541	inconsistent
1947	342	− 44	8,481	inconsistent
1948	386	15	− 24,701	inconsistent
1949	371	− 91	− 9,789	consistent
1950	462	− 91	− 77,003	consistent
1951	553	−135	− 27,975	consistent
1952	688	74	−166,007	inconsistent
1953	614	305	−218,490	inconsistent
1954	309	−189	101,927	inconsistent
1955	498	− 75	− 79,826	consistent
1956	573	202	143,393	consistent

with a linear demand curve, for instance, such a storage policy would have increased the total revenue from a series of crops.[10] Table 2 indicates that in 16 years, the policy carried out was inconsistent with this hypothesis. In 12 years, it was consistent. The ever-normal granary concept was violated by the actual storage policy regardless of whether stabilization or destabilization was called for.

[10] Given the probability for predicting the size of the crop, a statistical test for this hypothesis can be devised. The probability of predicting whether the next crop is going to be larger or smaller than the present crop is not independent of the crop size since a large crop is more likely to be followed by a smaller crop than a small crop to be followed by a smaller crop. A one-tailed test is needed for either the hypothesis used or its alternative. However, tentative estimation of the probability of making 12 correct guesses or less out of 28 using a binomial distribution indicates that such an outcome is better explained by chance than by either hypothesis. Indeed this is self-evident.

Since there seems to be some tendency for stocks to build up to high levels and then dissipate rapidly, it may be argued that a policy of destabilization is being carried out. However, these stocks never tend to be reduced when prices are low. Thus, there seems to be no effort to manipulate prices to high level and reap these benefits and then discard the surplus so gathered by throwing it on the market in a single year.

Summary and Conclusions

The July 1 stocks of wheat in Canada for the years 1956, 1957, and 1958 were 620, 765, and 650 million bushels, respectively. The largest Canadian crop on record was 688 million bushels in 1952. These carryover stocks are more than half again as large as a normal Canadian wheat crop. Storing such large quantities of wheat is a considerable expenditure of resources which should quite readily be justified. An examination of the returns from the Canadian wheat storage program in the past indicates that this is not the case.

Speculative losses which have been defined as the change in the average wheat price from one year to the next plus the cost of storage multiplied by the quantity stored have been substantial. These losses are an estimate of real losses that could have been avoided if speculation in wheat had been carried on by private individuals or if the agencies making the speculative decision had been aware of the fact that speculative returns were involved and if they had been more adept in their sales policy. Since no clearly defined monetary benefits can be identified as an offset for these losses, it must follow that the over-all price to the Canadian farmers would have been greater if there had been no government or farmer interference with marketing of Canadian wheat.

Looking at the other aspects of the Canadian policy, one sees that the Canadian wheat policy was not necessary in order to carry out the other government programs affecting wheat producers. Secondary benefits in terms of the ever-normal granary from the Canadian wheat policy are doubtful: firstly, because the nature of the demand curve for Canadian wheat is not likely to be of the shape necessary for important benefits to accrue; secondly, the program actually carried out was not such as to take advantage of any possible benefits. Temporary benefits are also very questionable. If the long run demand for Canadian wheat is elastic, any increase in price obtained by storage is gained at the cost of reduced prices in the future even after the stocks have been released.

REORIENTATIONS IN RESEARCH IN AGRICULTURAL ECONOMICS

GEORGE K. BRINEGAR, KENNETH L. BACHMAN AND HERMAN M. SOUTHWORTH*

AGRICULTURE in the United States is in a period of critical change. The forces of change include rapid technological advance, rapid growth and structural change in the industrial and commercial environment within which agriculture functions, and an accompanying intensification and realignment of political pressures impinging on agriculutral policy.

The response of agriculture is confused: There is a welcoming and rapid adoption of some types of changes, resistance to others that may be inevitable concomitants of the changes that are adopted; an intensification of the contradictions between responses to which farmers are motivated individually and the collective consequences of such responses for the welfare of the group; resulting strong political conflicts between those who seek at all costs to protect the group and those who believe that attempts in this direction only prolong the agony of adjustment, at great public expense, and with attendant undermining of the very values (moral as well as economic) that the farmers' advocates seek to protect.

The economic and social consequences of these changes in agriculture are far-reaching and arouse wide-spread concern. These consequences include serious chronic distress within major sectors of agriculture itself, in spite of public remedial programs that have grown to unmanageable proportions, and an accelerated movement of population out of agriculture that nevertheless appears to fall short of the rate needed for economic adjustment. Among families that remain in agriculture, the income gap widens betwen those able to adopt progressive technology and those lacking the necessary financial resources or personal capabilities. Successive sectors of agriculture are being increasingly controlled by outside com-

* Subcommittee of the Social Science Research Council Committee on Agricultural Economics, for whom this report was originally prepared. It was submitted to the Executive Committee of AFEA and to the Council's Committee on Problems and Policy, with the result that new committees on research in agricultural economics with overlapping membership were appointed in January, 1959, by the Association and the Council, to concern themselves with planning research in neglected areas. The Council committee consists of Mr. Southworth, Chairman, Messrs. Bachman and Brinegar, and Robert L. Clodius, Sidney S. Hoos, Marc Nerlove, and William H. Nicholls. The same persons have been appointed to the Association Committee, together with the two most recent past presidents of the Association, H. B. James and Harry C. Trelogan.

A condensation of this report was published in Social Science Research Council *Items* (13:1; March, 1959). The report is presented here in amplified form for its interest to members of AFEA.

mercial interests. Areas of traditional economic leadership in agriculture are challenged by new areas of agricultural economic growth.

The concern with these consequences reaches all strata of the agricultural population and all groups concerned with agricultural welfare. It is expressed in the desperate clinging to remedial policies and programs that have long since been shown to be bankrupt; in the grasping at new remedies that conflict with important policies of national interest, as in forcing exports; and even in such radical proposals as substantial curtailment of public support for agricultural research and extension, in an effort to slow down the rapid technological progress that some blame for agriculture's distress.

There are, of course, no simple, easily applied, costless, yet effective remedies for agriculture's ills. But they are not beyond constructive approach. That comments are so often only doctrinaire and that arguments seem so repetitious suggest failure on the part of agricultural economists to apply imagination, to depart from customary thought patterns, to break down the mental barriers that restrict their formulations of problems. In part this may be a result of the structure of institutions through which our work is chiefly conducted and supported. The safe practice of justifying appropriations in terms of familiar problems familiarly presented does not stimulate new and more fundamental approaches—nor does the drawing of sharp agency fences around "areas of responsibility" that enclose only parts of problems, nor the catering to specific requests of particular groups for work on problems narrowly formulated in advance. The institutionalization along state lines similarly tends to force formulations of problems into geographic boundaries that fail to encompass the main economic problems of today's agriculture. The Regional Research Program was intended as a vehicle for broader attack, but there seems to be general agreement that we have failed to realize its potentials for research.

The more basic compartmentalizations of thought, however, are disciplinary ones, originating out of the formulations of the past: farm management; the financing of farming enterprise; the use of agriculture's distinguishing resource, the land; the analysis and forecasting of market forces in terms of their expression as prices; marketing, first as an operation whose costs impinge on farmers' returns, more recently as a positive instrument for the enlargement of markets; cooperation as a vehicle for group solution of the foregoing problems. (To these should be added the concerns of the sibling discipline of rural sociology with problems of the rural community and its services to the farming population.) In each of these problem areas a subdiscipline grew up, with specialized concepts and methodology. The crystallization of these subdisciplines bounds the structure of problem areas formulated in agricultural economics today.

Each of these problem areas was a vital one in its time. Each remains a useful focus for many purposes. It is not intended here to imply that the present work of the profession is fruitless, for the traditional problems continue to be important. But it is argued that we are failing to measure up to the present challenge, and will continue to do so unless and until we can direct our thinking to new and broader formulations of problems as they now press upon us. Yesterday's formulations do not appear to provide keys, either individually or collectively, for unlocking the dominant problems of today.

The Diagnosis

It is our thesis that many critical economic problems currently confronting agriculture are not divisible into traditional thought compartments; that a too complacent or too rigid adherence to those compartments handicaps both imagination and breadth of attack; and that there is therefore need for bursting these bonds in order to achieve more creative approaches. Changing times call for changing strategies—for reformulation of problems into new categories, and for a corresponding regrouping of our intellectual forces. Restricting our efforts to our traditional thought compartments can be expected to generate only fragmentary research results.

What are the sorts of problems on which we are ineffective? A series of brief summary statements of such areas follows. The list is illustrative only; it makes no claim to comprehensiveness, nor even to matured formulation of the areas that are discussed, but it offers some substantiation of our thesis.

Technological change

One problem area comprises technological progress and its impact: not technology as a problem of farm management and extension, but as a force of ramifying impact, both macro and micro, a force now left to operate blindly. There are few attempts to anticipate its economic consequences in general or in particular, much less to prepare the way for coping with them. That traditionally progressive farm groups question the allocation of resources to technological research is but the corollary of this lack of forethought. Such questioning is wholly legitimate in economics. But it requires generalization to the broader problem of optimum allocation of resources in an industry capable of the rapid technological advance of agriculture and having its demand characteristics and other conditions; and to the counterpart questions of optimum organization of production and equitable distribution of returns to both the functional and the human resources in such an industry. The impact of technological change on the beliefs and valuations of farmers and others and the impli-

cations for economic organization likewise require investigation. We need, in short, an economics of technological development in agriculture.

Agriculture in an economy of abundance

These considerations lead promptly to another broad subject: the market position of farm products in an economy of abundance based on rapid technological progress. This is not merely "marketing" in the traditional sense. Rather, it requires combining fundamental study of consumer behavior with structural analysis of the type underlying modern price studies, and both of these with analysis of production response on the supply side. Involved are questions of the changing effectiveness of price as a motivating force and hence as an efficient regulating or control mechanism in our high-income economy, the necessity of promotion for maintaining consumption, and the implications of these for resource use, for the organization of markets, and for income distribution to and within agriculture.

Changing structural relationships in agricultural production and distribution

A closely related problem is the impact on agriculture of the changing structure of related industries in our growing economy. The current concern over "contract farming" and "integration" is a facet of this, as is the decline of open markets as focal points for "price discovery." This area likewise is not to be encompassed within the traditional field of "marketing." It reflects the breakdown of those economic mechanisms between production and marketing that permitted separate compartmentalization of them in the first place. It ramifies into agricultural finance and injects new forces into the analysis of interregional competition.

Agricultural-industrial interrelationships

A further vital problem area of the current scene revolves about increasingly intricate interrelationships of agricultural and industrial and other nonagricultural activities. Involved here are such matters as the transfer of agricultural resources to industrial uses and the increasing dependence of commercial agriculture upon industry, both for inputs and for processing and marketing its products. Competition between agriculture and industry in the labor market, nonagricultural use, ownership, and control of rural land and water resources, and competition of new industrial products in traditionally agricultural markets are varied facets of the picture. Others are industrialization as a means of economic development in rural areas, and the impact of suburbanization and growth of nonfarm rural population on rural communities and the services they must provide. It is characteristic of such problems that they cannot be adequately examined

within the framework of the economics of agriculture or of any other single sector. Agricultural research must be integrated with other kinds of economic and social studies. Yet many problems of this sort have greater implications for the future of agriculture than do some of those internal to agriculture.

American agriculture in the world economy

A peculiarly critical problem today relates to the whole role of American agriculture in the world economy. This role clearly cannot be examined adequately within the framework of agriculture alone. Insofar as policy is concerned, the whole pattern of our foreign economic objectives is involved. Unilateral giving away of surpluses is not a "world approach." And even in regard to agriculture itself, the production and market situation is characterized by the desperate drive for economic development in most countries of the world. Static analysis of comparative advantage fails to cope with the dynamic and evolving world situation. Economic development is not accomplished by grafting American know-how onto another economy, branch by branch. The character of the other economy must be understood, its limitations allowed for, and its potentialities encouraged into growth after their own pattern. This implies a conceptual approach highly flexible in its application.

Public assistance for rural resources

A number of government agencies participate in supplying facilities and services to farmers and rural areas. The Rural Electrification Administration electric power and telephone programs and the Farm Credit Administration and Farmers Home Administration programs for tailoring credit to farmers' needs are examples.

Agricultural economists played a prominent part in the inception of such programs by demonstrating needs that were not being adequately met by existing proprietary institutions. The changing situation of agriculture, including developments arising from the programs themselves, has radically altered the circumstances under which they operate, both in terms of problems they face and in terms of opportunities for service. But the present generation of agricultural economists seems largely to have neglected the necessity for continuing review and reappraisal of needs and performance in this area of rural resources.

The time is ripe for a series of studies of such programs that will trace their origin and development, analyze the situations that they face currently and prospectively, and clarify public thinking regarding relevant economic issues. A more fundamental task is the development of standards for judging the merits of public assistance to undertakings of this kind.

Income goals for agriculture

Chronic complaints have been heard about the failure to carry through basic research in anticipation of the needs of policy development. Here the underlying difficulty may be more institutional than disciplinary, although it is by no means wholly so. Agencies responsible for policy have been hesitant either to take leadership themselves or to support research by analysts over whom they have no control. Meanwhile agencies without such responsibilities are hesitant to jeopardize appropriations by entering this controversial field.

Particularly relevant to policy, but basic also to the critique of much research in other areas, is the question of income goals for agriculture. Here, again, controversy has perhaps an inhibiting influence on research. But a great contribution to our thinking could be made through objective analysis of the implications of alternative goals for farm income and its distribution, how these are affected by the economic changes that are occurring, and how income allocation within agriculture and between agriculture and the rest of the economy affects the level of income available for distribution.

Systems of thought, research methods, and findings

Finally, the complaint is raised that research in agricultural economics typically is fragmented—that we too seldom systematically compile and synthesize our knowledge in terms of logic and theory, of research methods, or of empirical findings. This criticism in part reflects the failure of our traditional thought compartments to encompass problems of the kinds described, with the result that concepts with which to organize our thinking more effecively are lacking. But even within our existing subareas of specialization, systematization of knowledge is often inadequate. One cause suggested for this is the intellectual climate within the institutions that support us—the emphasis upon applications, the failure to leave workers free for the less "urgent" professional tasks, the tendency for professional recognition and rewards to go to those who move most rapidly from project to project. Yet we ourselves help create this environment, and it is largely within our power to change it. We must recognize that part of our failure to address ourselves competently to critical current problems, broadly conceived, arises from a lack of ready command over the knowledge that we do have but cannot bring to bear in its fragmented state. This shortcoming thus springs from still another "neglect" that as a profession we should endeavor to remedy.

Suggested Steps

Reorienting our professional thinking so as better to come to grips with

the critical emergent problems of today's agriculture will require more emphasis on:

(1) Identifying and directing attention to these problems;
(2) Formulating them imaginatively, as whole problems, not as separate pieces, assumed to be independently soluble by traditional approaches;
(3) Organizing our existing knowledge so that it may be utilized effectively;
(4) Identifying the gaps in our knowledge—in theory, in methodology, in empirical studies—that must be filled to enable us to attack the problems;
(5) Undertaking the research needed to fill these gaps.

To accomplish these things will require some innovations in our *modus operandi*. In addition to delineating the problems and directing professional attention to them, it will require giving encouragement and support to those stimulated to undertake the needed research. This includes not merely making funds available in support of appropriate "projects." It means fostering a continuing professional environment in which workers will be challeged to undertake the essential tasks and will feel assured that these offer attractive career opportunities comparable with those in the familiar grooves.

A further requisite will be to broaden the range of professional competence brought to bear on our problems, both institutionally and in terms of discipline. Greater interest must be encouraged among workers in private as well as public institutions, and active participation must be drawn in at many points from general economics, from the other social sciences, and from philosophy.

Finally, marshalling effectively the intellectual forces unleashed in the foregoing process will require developing new generalists, able to draw ideas from more than a single subdiscipline in formulating and attacking the problems we face.

Amplification

The preceding discussion listed a number of problems that appear currently neglected in agricultural economics research, or in which reorientation of research effort might contribute to greater effectiveness. These are amplified in the comments that follow, with some tentative suggestions regarding reformulations of the problems and types of studies needed.

1. *Technological change*

Lack of an adequate theory of growth or economic development is the most obvious need of agricultural economists, as of economists generally. The direct quest of such a theory does not appear promising, since no

science has adequate understanding of cumulative change. Many of the relevant questions must therefore be cut from a finer canvas than that of a general theory. The following observations are intended to suggest a possible formulation of the problem of technological development that can lead to questions susceptible to useful and promising research.

Technological change, defined as the effects secondary to the accumulation and application of knowledge, is at once the source of hope for the future and the cause of most of the adjustment problems faced in the present. A society without an advancing technology would be a society largely without meaningful problems in an action sense. It would face a set of largely unalterable conditions rather than a set of obstacles to be overcome through new ways of doing things. Thus the existence of technological change makes it possible for man to treat the old constants as new variables or as "problems."

Given the above notion of technological change and of problems, the future can be expected to generate new problems, and at an increased rate, since technological developments (1) open up new opportunities for individual firms and households, (2) make old institutions and organizations obsolete after the new technology is widely used and (3) transform old constants into variables as it becomes possible to do something about conditions that were in the past considered fixed by the nature of things. Such new problems range from the mundane to the out-of-this-world. It is only recently that we in the United States have been able to define as serious problems, in the action sense, such items as the common cold, too much food, and going to the moon.

Technological change must be seen in its Dr. Jekyll and Mr. Hyde facets if one is to ask some of the most meaningful research questions. Each new development creates secondary problems. In agriculture most research effort has been devoted to decreasing costs, with the effect of increasing the output of food and fiber. In proportion as such research has been successful adjustment problems have been created both in Agriculture and in other sectors of the economy. Likewise, new horizons are opened as the impossible becomes, first, the possible, then the likely, later the accomplished fact, and finally the obsolete.

An array of useful questions center on the measurement of technological change. These questions concern levels and rates of change, and are significant at all degrees of aggregation. A second interest area concerns the factors that are strategic, at various times in various societies and industries, in determining the development and adoption of technology. Flowing from these questions is another; that of how to alter the rate of economic growth, at both the micro and macro levels.

The impacts of technological change are not adequately quantified or even understood. For example, many have stated that "diminishing re-

turns" are not operative in agriculture. Can it further be demonstrated that the economy operates as if constant or increasing returns were the general case? On the side of income distribution there is need for more accurate measurement of the incidence of the gains and losses to various groups from new technology. It is not enough to say that all society gains in the long run. Interest in the question of incidence implies interest in how to shift the gains and losses flowing from technological change. Thus questions arise concerning how to control the impacts of technological change and how to shift them.

Adequate measures of the impacts of technological change and techniques for shifting their incidence would open the doors for speeding the rate of economic growth, since many of the disrupting effects of change could be dampened or avoided.

Closely related is the question of changes in relevant beliefs and value systems of farm and nonfarm people in an increasingly specialized, highly technical system of agricultural production. Are modifications occurring in the image of the farmers' role as regards, for example, the scope of independence of management decision that is feasible, or as regards the degree of personal responsibility for economic security in a rapidly changing world? Shifts in value patterns related to such things can enlarge the range of acceptable choices in responding to problems that accompany technological advances.

Although the whole area of technological change is too broad to attack frontally, since it involves most of the things considered problems, we can chop away at its pieces and bits. Yet we cannot rest with this approach, but should devote substantial effort to a synthesis of these pieces and bits, even though a general theory is not yet on the horizon.

2. *Agriculture in an economy of abundance*

The substantial rise in real incomes in the U. S. in the last couple of decades, plus other changes, suggests a radical shift in the character of the consumer market, one of particular import for farm products. We are working on a different part of the Engel curve. Presumably income elasticity is lower, and one can make a plausible argument that price elasticity, at least for foods collectively, should be lower too.

One might suppose that demand would be stabilized, also. But high income is a concommitant of high-level production that engenders strong competitive sales pressures. "Selling" has become a major industry; and advertising and merchandising techniques designed to "stabilize upward" the demand for each item may have the collective effect of destabilizing demand, or at least of making stability precariously dependent upon continuously successful promotion of a product.

Substantial expenditures, including public and quasi-public expenditures, are made to maintain the position of various farm products in this competitive struggle for the consumer's dollar. Appreciable public funds are spent on research to devise and test promotional and merchandising methods for farm products, and to explore consumer preferences regarding them. Some studies also are being made to get at more fundamental characteristics of consumer behavior relative to agricultural commodities, and the factors underlying it.

Such a change in character of the consumer market has important implications for public and private policy with respect to the marketing of farm products, and likewise with respect to production. To analyze them effectively requires drawing upon the abilities of the consumption economist, the welfare economist, the social psychologist, and, ultimately, the value theorist in philosophy.

Assuming that reasonable goals can be established for the consumption of farm products, individually and by groups, very practical problems arise as to the best methods of promoting such levels of consumption, and the best arrangements for gearing production to supply them. On the promotion side, what channels of distribution and what sales methods should be used? In what forms should products be marketed? How can the interests of the various groups involved—producers, processors, distributors—be brought into agreement? How can the cost of promotion be equitably shared? Recognizing the extent of competition between farm products, how can we minimize competitive waste in expenditures for promoting their sale?

On the production side, how can needed adjustments to prospective demand best be brought about for the different farm products? Does the present type of market require a degree of integration of production, processing, and marketing that open-market trading cannot provide, especially if the presumption of decreasing elasticity of demand is correct? If production must be continuously regulated otherwise than by the market, can private groups achieve this, or what degree of public supervision or operation is required? How can the burdens of this best be shared among producers? Can methods be devised for providing, in the interest of abundant consumption, a margin of safety against yield fluctuations without endangering producers' returns in years of good yield?

Behind these immediate questions lie more fundamental ones regarding the nature of consumer demand and the extent and manner in which it is changing, the longer-run consequences both of short-run promotion schemes and of short-run supply-control operations, the manipulability of consumer demand by promotional devices, and—most fundamental of all—to the degree that consumer choice becomes a manipulable, endogenous

variable of the system, where can new anchorage be found for the theory of value in economics, when its moorings in the principle of free consumers' sovereignty are thus torn loose?

Answers to some of the later, more fundamental questions, especially, must obviously be sought outside the realm of agricultural economics itself. But it is important to bring to bear upon agricultural economics such enlightenment as can be found on these issues. And within agricultural economics, a problem area is presented here that involves both production and marketing and the organization of relationships between them, and that has important implications in price analysis and for public policy.

3. *Changing structural relationships in agricultural production and distribution*

The problem of many small farmers facing a few large and expert buyers in the market has traditionally been formulated in terms of laws for control of monopoly or devices for strengthening the bargaining position of the farmers either through collective action or though informational and grading services. In our present economy, this formulation of the problem appears inadequate and unrealistic.

The growth of the consumer market makes efficient mass distribution essential, and it is difficult to see how this could be accomplished without enterprises of large scale. The character of that market suggested in the preceding section, the structure of competition in processing and distribution, plus technological developments, have forced innovations in procurement practices that appear to justify themselves in the name of efficiency. Large-scale processors and distributors require reliable, large-volume sources of supply of products of uniform quality whose merchantability they can depend upon. The question is not one of restoring an earlier order but of understanding, adapting to, and realizing for farmers as well as others the potential advantages of the new system.

Cast in these terms, the problem for research is, first of all, a clear delineation of the new order and its requirements. A commodity-by-commodity analysis will likely offer one advantageous approach here. In each case it will call for developing an accurate, integrated picture of the combined structure of production and distribution and the dominant factors, both technological and structural, that determine the direction that the pattern of organization is taking for the commodity.

Such analyses must be combined with studies that look beyond commodity boundaries, however, since the enterprise pattern on the distribution side is not in most instances commodity oriented. Furthermore, inter-commodity comparisons will be enlightening, since the pattern of development in one commodity may foreshadow that in others in which strategic technological developments are later in time sequence.

The ultimate aim of such studies should be to build up a picture of the alternative structural possibilities, susceptible of appraisal from the standpoint both of farmers and of other groups concerned. This will require broadening our morphological classification of entrepreneurial systems and extension of economic theory regarding decision-making, risk bearing, concentration and control of production planning, and other functions of entrepreneurs in the farm-product industry. Delineation of alternatives will require exercise of considerable imagination in devising new possibilities that meet the requirements of typical situations in ways that offer promise of mutual advantage. Social-psychological as well as economic analysis can contribute to the formulation of acceptable choices.

Meanwhile, attention must also be given to the situation of producers and producing areas adversely affected by present or prospective developments, and to devising ways that can be opened to them for overcoming their disadvantaged positions.

4. *Economics of agricultural-industrial interrelationships*

The increasingly important interrelationships between agriculture and industry have already brought far-reaching changes in the structure of agriculture and the rural economy. The rapid growth in commercial and industrial activities is involving significant transfers of labor, land and water resources from agricultural to industrial, residential and recreational uses. At the same time the commercialization of agriculture has meant increasing dependence on nonfarm sectors for resources and for processing and distribution. Continuation of these trends in the growth of nonfarm rural activities and in the commercialization of agriculture will further increase the importance of these agricultural-industrial relationships.

Research to provide a basis for evaluating the alternative uses of resources between agriculture and other sectors of our economy and to appraise the effects of changes in one sector upon the others in the framework of a dynamic economy is critically needed in agricultural economics. Such studies would focus on the interrelationships between sectors of our economy, between production and consumption, and between public and private aspects of economic development.

The analysis of agricultural-industrial use of farm labor is an important example of research in this area. The functioning of nonfarm labor markets has, in the opinion of many economists, highly important effects on the current and prospective income problem in agriculture. In particular, in many low-income areas substantial shifts to nonfarm occupations will be necessary to provide productive employment for farm youth reaching working age and to permit the development of larger, more efficient farms. Additional research is needed on why substantial differences in farm and

nonfarm earnings arise and persist. What are the effects of deviations from competitive conditions in the nonfarm labor markets upon farm-nonfarm income differentials? How will the present social and industrial ferment in the South affect agricultural labor and the problem of low incomes there? What are the educational and managerial requirements and the associated levels of earnings of different types of employment in agriculture and industry? What are the factors affecting the spatial and occupational mobility of farm labor?

Also of considerable significance to agricultural development generally and particularly to low-income areas are the factors affecting the mobility of industry and of nonfarm capital. What factors are involved in the growth and location of industry? What are the impacts of industry on the agriculture of an underdeveloped area? What determines the availability and use in agriculture of development capital from nonfarm sources?

The increasing importance of the nonfarm sector of our economy has many impacts on the use, ownership, and control of rural land and water. The nonfarm sector will exercise increasing control over rural lands for residences, recreation, highways, airports, and other types of nonfarm activities. What farm and nonfarm needs for land and water resources are implied under different alternative assumptions with respect to growth and development? To what extent are these uses of water and land competitive? How does the productivity of various types of land compare in farm and nonfarm uses? What are the "costs" of using lower qualities of land in industrial and suburban developments? What possibilities exist for expanding "reversible" uses for recreation, wildlife, etc., as part of adjustment programs?

More adequate theories of economic development are needed for evaluating allocation of land and water resources among sectors of our economy. For example, the evaluation of agricultural and industrial-municipal uses of water must be based on underlying theories with respect to economic growth, interrelationships among sectors of our economy, and public and private economics. Assumptions made with respect to prices, technology, secondary effects, and possible complementary relationships are now frequently conflicting.

Problems raised by the increasing numbers of people living in open-country areas need more attention by both sociologists and economists. Of special importance are the problems involved in providing educational and social services in a decentralized environment. The increasing urbanization of the economy has brought about fundamental changes in the status and function of many smaller local governments. Can we attain a better allocation of social services and their costs in rural-urban fringe

areas? What changes in educational services are needed to better equip youths to take advantage of prospective vocational opportunities?

Finally, there is a vital need for more study of the implications of the growing interdependence of agriculture and nonfarm activities. What effects does the growth of the interrelations have on the extent to which farm production responds to prices? What effects does it have on income stability? What are the possibilities that agriculture may run into severe competition from the nonfarm sector in the production of food, as it already has in the case of fibres?

Partly because our action and research programs have placed heavy emphasis on studies within agriculture or within other sectors of our economy, these broader problems of resource use have not been given adequate attention. Actually, many of these questions may have greater implications to agriculture than further analysis of studies within agriculture itself.

In several of the research studies of this type, agricultural aspects represent an important aspect of a broader study. This suggests the need for more emphasis on agricultural research in general economics institutions and in general economic studies.

5. *The role of American agriculture in the world economy*

The development of a rational world economic perspective for the formulation of domestic agricultural policy, programs, and adjustments represents one of the major challenges to agricultural economics research today. Such a perspective will depend upon a better understanding of the relationship of domestic agricultural policy to foreign economic policy of the United States and to economic development in the rest of the world. Especially needed are some means of freeing comparative-advantage analysis from static assumptions regarding production organizations within different countries, methods of analyzing social and economic interrelationships in production and consumption, and a more adequate theory of economic development.

Basic questions that require research include the following:

What are the probable effects of economic growth and development of underdeveloped countries on the kinds and amounts of food and fiber demanded? Fragmentary analysis of these relations gives evidence of relatively highly elastic demands for food in such countries. It also indicates substantial shifts in the nature of food demands. Analysis of this problem should go beyond study of income elasticity into study of other factors in economic development that affect food and fiber consumption.

What are the effects of alternative ways of disposing of American farm surpluses upon the economic growth of other countries and their demands

for food? What possibilities exist for a world approach to the use of farm surpluses? Under what conditions can these surpluses be used to foster economic growth and development? These questions require study of production potentials both in agriculture and in other sectors of the economy and a balancing of these potentials against prospective needs.

Domestic agricultural policy must take account both of domestic and of world-wide prospective demands and productive capacity. Considerable work has already been done or is underway on the domestic aspect. It is perhaps even more important to make some evaluations for the world as a whole. Such research would ultimately require close cooperation between physical scientists, economists, and other social scientists.

Closely related is the question of factors basic in determining economic growth in underdeveloped and in commercial countries. In this area something more than static economic analysis is needed. The extent of complementarity in the development of industry and agriculture needs a more thorough examination. Problems of capital formation and allocation are critical. Little information exists on the prospective returns from various combinations of investments in agriculture and other sectors in the various countries.

How are the cultural and philosophical patterns of the people in the various countries related to present and potential programs for economic development? This is an especially fruitful area for cooperative research between sociologists and economists. Experience in development programs throughout the world demonstrates the critical importance of cultural and philosophical patterns.

In addition to meeting needs in development of a more enlightened policy with respect to world agriculture, research on the problem mentioned can strengthen economic science in at least two ways. It provides a favorable environment for further development of socio-economic research, and of dynamic approaches in economic analysis.

6. *Public assistance for farm resources*

Over a period of years national programs have been introduced to make available to farmers selected resources needed for improved production or rural living. Electricity, telephones, several types of credit, and managerial aids, provided by such agencies as the Rural Electrification Administration, the Farm Credit Administration, and the Farmers Home Administration are examples.

At the time of their initiation, these programs were regarded as the best alternative for supplying facilities and services that were not adequately provided by proprietary institutions then existing. The programs have yielded undoubted benefits to farmers and other rural residents, and have

resulted in the establishment of new institutional patterns by now largely taken for granted. Yet partially as a result of the programs and partially because of exogenous developments within agriculture and within the economy at large, the circumstances that led to their creation have been radically altered. New and different problems have arisen or the old problems now confront farmers in different forms and degrees.

The very nature of the programs make periodic public review of them desirable. Such reviews by administrative and legislative bodies, however, seem to have involved little participation on the part of agricultural economists. The broader implications of these programs for economic development regionally and nationally, and the impact of the resulting changes in institutional relationships, production patterns, industrialization, and rural living, seem largely to be neglected by the present generation of agricultural economists. Changes in policies regarding these programs that have been suggested from time to time have claimed wide-spread public attention and have at times evoked heated legislative debate. On many of these issues there is a widely felt need for objective information and analyses that would help those endeavoring to judge the merits of proposals.

Such programs assume institutional forms and procedural methods that vary as widely as the problems with which they deal. One common characteristic is that they depend to greater or less degree either directly upon the U. S. Treasury or upon governmental backing for the funds they obtain from the money markets. A number of these programs have operated long enough to permit comprehensive analyses of their achievements, their current needs, and their probable further contributions to farm production efficiency or to improvement of rural welfare. Such analyses by competent economists and allied social scientists would provide a much better foundation for intelligent judgment regarding the public investments now justified for the programs and the length of time or the circumstances under which they should be continued.

New proposals, like those concerned with area development, are currently under public consideration. Thorough analysis of existing programs that offer comparable experience could help both in appraising new proposals as objects of public investment and in perfecting the operation of those that may be adopted.

One possible approach to the economic evaluation of the programs would be to draw upon existing theory and knowledge to formulate standards for judging the merits of such programs as claimants for public assistance. Current problems and needs might then be compared with the standards. A basic consideration would be the circumstances in which the private money market may be precluded from investment in activities

whose probable benefits will accrue largely to future generations. Secondary effects, such as speeding farmers' adoption of new technology or facilitating rural community development, obviously are relevant here.

Another, initially probably more productive, approach would be to undertake a series of reviews of selected programs. These reviews would outline the circumstances leading to the original needs for the programs; trace their development and evolution to their present form; identify the emerging or different problems that have arisen; describe the group interests associated with the programs, either as direct beneficiaries, or as secondary or tertiary beneficiaries; and delineate the institutional patterns they have taken. Such information, adequately documented and analyzed, might be expected to lead to constructive recommendations from the economic analyst. Certainly they should provide a better basis for the exercise of intelligent value judgments by those holding administrative or legislative responsibilities for the programs, as well as by the public at large.

7. *Income goals for agriculture*

One of the great problems in agricultural policy is the lack of consensus concerning income goals for agriculture. To many this is a question beyond economics, to others, a legitimate concern of economics but beyond economists. Yet the fact remains that economists and others, not only when working in policy but in other areas as well, make recommendations that, if followed, will affect both the distribution and the total amount of national income.

Historically, economists have been greatly concerned with income distribution, the fair price, and the exhaustion of the total product in payments to the factors of production. Additionally, much discussion has centered on the relation of income distribution to total national income. At a more general level the whole problem of welfare economics is involved, as well as value theory as the philosopher approaches it.

In the Keynes' frame of reference, for political economy, income goals for agriculture involves positive economics, normative economics and the art of program implementation and operation.

At the applied level of agricultural economics, we have various price and income "parities," plus concepts pointed towards the test of prices required to bring forth adequate supplies, the test of equal returns for comparable factors of production, returning cost of production or cost plus, etc. Not only average income and price, but the variability in these magnitudes over time as well as among individuals is a matter of concern.

An adequate perspective of "income goals for agriculture" requires that it be examined with reference to (1) available choices, (2) changes that

are brought about by technological development and (3) the level of productivity of the society. Only a rich society is in a position to set up income goals that are meaningful in an action sense, where the notions of equity and justice play major roles. Only in progressive societies is the distribution of income changeable enough to raise equity problems affecting, personally a large percentage of the population. A society is indeed fortunate to be seriously faced with such a problem as the determination of income goals for agriculture.

In general the questions that are asked about income goals for agriculture are oriented in one of three or four directions. One looks at income distribution as the effect of the use made of resources and hence as a means of allocating resources efficiently. A second orientation is that of equity and justice where the matter of efficiency becomes secondary. A third approach is to inquire how income must be distributed if the economy or society is to work. (Many, including Marx and Keynes, have had their say on this subject.) A fourth approach leaves the normative frame of reference and examines possible techniques for reaching stipulated income goals.

In agriculture, past analyses have often fallen into disrepute as expressions of agricultural fundamentalism; e.g. the seven-to-one notion. The more modern versions of this type of thinking start, not with the notion that agriculture is good, or fundamental, but that it is different or a special case. In spite of the usual barrenness of these approaches one is not justified in concluding there is no pay dirt in them. They are, however, difficult in that they require the use of specific rather than of generic concepts.

If research is to be restricted within either of the first two frames of reference, it is doubtful that more than modest gains will result. The need is to get beyond the blindness imposed by the structuring of the questions in these frames of reference. One possible escape from these "traps" is the development of a society in which the possible personal gains from "robbing Peter to pay Paul" become quantitatively small compared with the personal gains that flow from speeding the rate of growth in real per capita income. Other avenues of escape that have been talked about look toward a millennium where the economic problem is solved, where everyone has all that he wants. The other side of this coin, a position also preached, is to want nothing, or in less extreme form, to damn materialism and the other necessary but not sufficient conditions for a good life.

On the normative aspects of income goals, it is unlikely that research will yield generally acceptable answers. Nevertheless, a careful delineation of approaches, their presuppositions and comparative implications,

would contribute greatly towards clearing the air for more productive debate of policy issues.

On the positive approach, of alternative techniques for attaining given income goals, the problems are more easily definable in strictly economic terms. But even here much more systematic work can and should be undertaken. Whether the question is stated in terms of gross farm income, net farm income, income per farm or per farmer, a variety of techniques are applicable—supply restriction, demand expansion, discriminative pricing, direct payments, etc., as well as structural changes designed to enhance the relative economic power of farm producers. The possible methods and their combinations need to be rigorously and systematically specified, and comparative analyses made not only of initial benefits and costs to farmers and to other groups affected, but also of secondary effects, and of likely longer-run consequences. Even in a non-normative approach, useful conclusions can be drawn regarding the consistency or inconsistency of alternative actions with other goals present in our society.

8. *Systems of thought, research methods and findings*

Three neglected areas in agricultural economics research are suggested by the dearth of treatises (1) on the logic or systems of thought applied to agricultural economics, (2) on research methods and (3) on the accumulation of research findings. The materials available are usually in bits and pieces rather than in integrated, systematic, and exhaustive treatises. A more positive statement of this need is as follows: A more careful study of agricultural economics and of agricultural economists—by agricultural economists—would likely be productive. These neglected areas in agricultural economics appear to flow from a lack of study of the type that is the norm in philosophy, where a major part of the intellectual effort is devoted to the study and the extension of previously developed ideas.

Logic or systems of thought: For purposes of illustration the following suggestion is presented. An analysis of the intellectual efforts of agricultural economists is needed in the frame of reference of F. S. C. Northrop, *The Logic of the Sciences and the Humanities*. Such a volume or series of essays could be developed in many possible forms. Analyses could be made of schools of thought, individual economists, subject matter areas, etc. Such essays would likely place great emphasis on questions asked, concepts employed, types of research conducted and techniques of proof. Comparative studies would seek out the roots of divergent conclusions on fundamental issues. The usefulness of this type of publication would be that of enabling better understanding of the content, relevance, and process of accumulation of knowledge in agricultural economics.

Research methods: Essays in this neglected area, at one limit, would

overlap with the study of systems of thought. At the other limit, the concern might be with the specific analytical techniques that are needed and are available for various types of research.

Some years ago the Social Science Research Council sponsored the development of research handbooks. This is one type of publication that might well be encouraged.

A second type of essay that might be useful would consist of critical analyses of research methods employed in various types and areas of study. Examples are such subject matter fields as farm management or production economics, economic growth, marketing, policy, credit, specific commodities, etc. Comparative analysis would be valuable of the comparability of methods in fields complementary in terms of new problem foci such as have been outlined in preceding sections of this report.

Subject-matter compilations: Few attempts have been made to develop publications that exhaust major subject matter areas in agricultural economics. Publication usually takes the form of relatively brief, specialized treatments of topics that can be covered within a journal article, experiment station bulletin or U. S. D. A. monograph. The publication of more exhaustive treatises would accomplish several purposes. First, such reference volumes would be of great assistance to workers—and especially to new researchers—in the fields dealt with. Second, new knowledge would be gained as an author attempted to pull together and reconcile the materials already published on a subject. Third, the foundation would be put in place for the development of additional research that would build on and effectively complement the known. Fourth, the likelihood of useless duplication of minor research studies by various workers would be greatly diminished. Finally, such a marshalling of knowledge in each field would greatly facilitate efforts to bridge traditional fields in attacking new problems.

NOTES

A NOTE ON WILCOX'S 'FARM POLICY DILEMMA'

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WILCOX reports that confusion in the farm policy field "has been confounded in recent years by a failure on the part of many in leadership positions (including some with advanced degrees) to distinguish between facts and values."[1] He apparently believes that the "net benefits" of farm price support programs have been ignored by those who have stressed the costs and adverse effects of such programs.

As evidence of the net benefits of price support programs to farmers, Wilcox presents a year-by-year analysis covering the contribution of Section 32 purchases, changes in CCC loans and inventories, and direct government payments to net farm income. For years prior to 1952, Section 32 purchases were added to the increase (or decrease) in CCC loans and inventories and the total multiplied by 2.5 (on the assumption that the composite short-run price elasticity for farm products is -0.4) to obtain an estimate of the contribution of these programs. Beginning with 1952 adjusted figures described as representing "net removal of farm commodities from commercial markets" were substituted for changes in CCC loans and inventories.

The results of this analysis are described as "rough and incomplete" at one point in the article but they are subsequently referred to as "facts." There are cases, no doubt, where a "rough and incomplete" analysis can indicate the "facts" as clearly as a more sophisticated approach. In the present case, however, the oversimplification inherent in the analytical method used has produced misleading results.

The use of Section 32 purchases and changes in CCC inventories as measures of the impact of price support programs is highly questionable because it does not take disposal policies into account. To illustrate:

(1) Section 32 purchases do not necessarily represent a net increase in the aggregate demand for farm products. A substantial proportion of the commodities purchased with Section 32 funds is channeled into domestic consumption through eligible outlets. In fiscal 1956, for example, distributions of Section 32 commodities to schools, institutions, welfare groups, and non-profit organizations providing emergency disaster relief totaled $144.1 million[2] in comparison with total purchases of $179.1 million.

[1] Walter W. Wilcox, "The Farm Policy Dilemma," *Journal of Farm Economics*, Vol. XL (August 1958).

[2] Department of Agriculture Appropriations for 1959, Hearings before the Subcommittee of the Committee on Appropriations, House of Representatives, 85th Congress, Second Session, Part 2, p. 1120.

While the distribution of Section 32 commodities may increase consumption of the commodities distributed, it is unlikely that this could be accomplished with present distribution methods without producing substantial offsetting reductions in the consumption of other commodities. Surely, no one would argue that all of the school children who receive Section 32 commodities under the School Lunch Program would go without lunches if there were no such government programs.

(2) If the government spent $5 billion on purchases and put all commodities thus acquired into CCC inventories, the method used by Wilcox for years prior to 1952 would show a net contribution of $12.5 billion (2.5 times $5 billion) to net farm income. If, however, the government spent $5 billion on purchases and during the same year gave foreign countries an equivalent amount, this method would show no contribution to net farm income from this expenditure since there would be no increase in CCC inventories.

The fact that changes in CCC inventories were adjusted to a net removal basis for 1952 and later years raises questions relative to the method used to make such adjustments, and the reason this method was not applied to CCC inventory changes for earlier years and Section 32 purchases.

Although Wilcox concedes (in a footnote) that better data are needed, inadequacies in the data used are not the only—or indeed, the most serious—objection that can be made to his analysis of the effects of price support programs on net farm income. The fundamental deficiency in the Wilcox analysis arises out of the use of a year-by-year approach which fails to compensate for the effects of the programs under analysis on the conditions existing in later years. Wilcox refers to "the dynamic effects of the higher and more stable farm income in the earlier years on the level of farm output and prices in later years," but he apparently feels that failure to adjust for these effects does not affect the validity of his analysis.

It is unlikely that anyone would argue that price supports do not add to farm income in a year in which the government removes a large volume of commodities from the market. This is a short-run analysis in which production and demand are taken as given. But, application of a year-by-year analysis to historical data assumes, in effect, that both the production of, and the demand for, agricultural commodities have been the same as they would have been if there had been no price support program. These are untenable assumptions.

If, as Wilcox suggests, the increase in total farm output has been more rapid in recent years because of price support programs, it would appear that at least a part of what he calls the "contribution of price support" to net farm income is not really a contribution but an offset to the adverse effects of causing output to expand relative to demand.

The question of what has been happening to demand is also important.

By stating that his analysis does not include the gains resulting from the shift of productive resources from crops with a highly inelastic demand to crops with a more elastic demand, Wilcox suggests that price support and acreage control programs have improved aggregate demand. Parenthetically, it may be observed that no evidence is presented to prove that (1) there has been a shift in the direction indicated when all resources —not just acreage—are considered, or (2) assuming such a shift, that there would not have been a greater shift to the commodities that have the more elastic demand in the absence of the price support program. The point, however, is that the demand curves for individual commodities are not necessarily fixed except in the very short run.

The fact that demand may be inelastic and fixed at any given moment does not mean that a demand curve cannot shift to the right or left over time. Wilcox discounts short-run market expansion potentials in the domestic market, and ignores the question as it relates to exports. He also ignores the effects of farm programs on our ability to retain historic markets. To take a specific example, there appears to be evidence that the demand curve for American cotton has been shifted to the left (relatively speaking when economic growth factors such as population and income are taken into account) by reason of the fact that the price support program held an umbrella over the expansion of competing production, including foreign cotton, synthetics and other substitutable materials.

The real point of all of this is that: If one is to analyze the effects of price supports on farm income, it would seem that he should try to compare the income that farmers have received under the support program with the income that they might reasonably expect to have received under the conditions that would have existed over a period long enough to permit adjustments, if there had been no program—or if a different program had been in effect. The present writer does not believe that this can be done by analyzing historical data without adjusting for the effects of the programs that are being evaluated.

In evaluating "gains," adjustments should be made not only for the effects of government programs on output and commercial demand over a period of years, but also for any increases in production costs that may have been brought about by the programs in question. Since Wilcox has not attempted such refinements, his estimates of farm income benefits must be something other than "net" benefits.

Wilcox says: "Agricultural economists have sometimes assumed that the improved income position of agriculture has slowed down desirable migration out of farming. However, Professor Bishop has found that this is not true."

Bishop's findings actually were somewhat less conclusive than the above quotation suggests. His own summary of his findings is as follows:

"In summary, some of the provisions of farm programs have created forces that tend to impede the transfer of labor from farm to nonfarm employment. However, whether in fact, farm programs have resulted in less migration than would have been the case without these programs is a question that cannot be answered with the data at hand. Available data suggest that there is considerable underemployment of labor in agriculture and that many farm people stand ready to accept nonfarm jobs at prevailing wage rates. If this is correct, then we are forced to conclude that migration of labor from agriculture is not greatly impeded by existing farm programs."[3] (emphasis added)

At one point Wilcox indicates that rising land prices are in part the result of government programs. At another point he presents a table which shows that the "realized return per hour to all farm labor and management" has been declining while farm real estate values have been increasing. Others might conclude from this and other evidence that one effect of government programs in recent years has been to increase returns to land at the expense of returns to labor and management.

Wilcox suggests that stable or rising land prices may have contributed to migration out of agriculture by permitting "farmers to leave farming without capital losses." While this could be true in some instances, it may also be observed that rising land values lead to capital gains, and that expectations of such gains can be a powerful deterrent to some farmers who might be thinking of selling out.

Rising land values and the expectation of further rises may also have served to pull capital into agriculture by attracting outside investors, and by broadening the capital base on which farm owners can borrow to finance production-increasing inputs. In this connection T. W. Schultz has observed, "Surely, many a farmer and landlord has enjoyed a marked rise in his relative wealth position in recent years, despite low farm incomes. These changes and prospects of such changes in wealth positions have affected resource allocations in farming. They, therefore, have been a factor in agricultural production."[4]

Wilcox contends that farmers' "income gains from price support programs have resulted in gains for other sectors of the economy" in the form of "additional workers released by investment in labor-saving machinery and increased output of food and fiber in subsequent years." The fact that such benefits are of a long-run nature again suggests the need to examine long-run, as well as year-to-year, effects on farm income.

There is no denying the fact that some sectors of the nonfarm economy

[3] Policy for Commercial Agriculture, papers submitted by panelists, Joint Committee Print, Joint Economic Committee, U. S. Congress, November 1957, p. 444.

[4] T. W. Schultz, "Omission of Variables, Weak Aggregates, and Fragmentation in Policy and Adjustment Studies," paper prepared for conference sponsored by Center for Agricultural Adjustment, Iowa State College, October 27-31, 1958.

—for example, certain individuals and companies whose welfare is affected by the volume of farm products that must be processed, transported or stored—have benefited from farm price support programs. It may well be that nonfarm sectors generally have received the "benefits" referred to by Wilcox, but it may be questioned whether "benefits" produced by a mal-allocation of resources are worth the cost in taxes and lost alternatives. Indications "that farm output per unit of total resources used has been increasing twice as rapidly in the past 25 years as in the 20 years 1910 to 1930" are evidence that the conversion of resources into farm products is becoming more efficient. But such evidence does not refute the charge that price supports and production controls have caused resources to be mis-allocated. Can the public really achieve a net gain from programs that cause scarce resources—some of which are exhaustible—to be dedicated to the production of unneeded surpluses?

Quite aside from the question of the exact contribution the support program has made to farm income in any one year, or series of years, there remains the question of whether such a program can be sustained indefinitely—and the ultimate consequences to farmers if it cannot. Those who have responsibilities relative to the determination of policy may be well advised to consider the implications of accumulated government stocks on prospects for farm prices and income in the future, as well as current results. "Gains" that are achieved by piling up inventories really represent an incomplete transaction.

While Wilcox indicates a belief that price support activities are in "urgent need of modernization," his contention that these programs have produced net benefits for both farmers and the public does little to support the suggested need for changes or to suggest the type of changes that are needed. Furthermore, he disparages the efforts of many in leadership positions—apparently meaning farm leaders and government officials who have been seeking to bring about changes in price support activities —by charging that they are motivated by "value judgments" rather than by facts. In the absence of specific illustrations of the alleged failure of individuals in leadership positions "to distinguish between facts and values" the possibility arises that the views of these leaders are affected by the relative weights they give to short- and long-run effects, as well as by "value judgments."

If there is a "great dearth of comprehensive analyses on which to base intelligent policy decisions," it may be that the "facts" with regard to long-run relationships between the costs and benefits of government programs should be more clearly established before farm leaders are charged with disregarding the "facts." In any case it would seem that Wilcox would do well to support his own conclusions with a more rigorous analysis before attacking other people's "value judgments."

ON THE WILCOX 'FARM POLICY DILEMMA': A REPLY

WALTER W. WILCOX
Library of Congress

HAMILTON'S note, although half the length of the original paper, presents no new evidence or analyses. He appears only to be interested in trying to minimize the contributions of farm programs.

Most of the issues discussed by Hamilton were briefly mentioned in the paper. With slightly different wording, almost all of the points might well have been added as footnotes. The conclusions would have been unaffected.

Criticism of the methods used to determine annual net benefits of the farm program are without foundation. Space does not permit developing the reasons why the points Hamilton raised have not led to an overstatement of the annual program benefits.

By far the greatest possibility of error is in the coefficient of price elasticity of demand for aggregate output. A coefficient of approximately −0.4 was used. Cochrane's studies and other evidence suggest it may be much lower than this.

All things considered, it is the writer's judgment that the estimates of annual benefits are on the conservative side because of the coefficient of elasticity used. However, as was indicated, more studies in this area are needed. Hamilton has not presented any new data in this area.

Only one other point will be dealt with, although if space permitted, all the points raised by Hamilton warrant further comment. Hamilton's thesis is that most of the short-run gains of the program are either required to offset the adverse longer-run effects of earlier programs or that they will be offset by adverse effects in later years.

Many agricultural economists share this view. Studies are urgently needed in this field. Why have we had a doubling in research funds in the past 6 years without any adequate studies in this field?

Until results of such studies are available it is pointless to attempt specific conclusions. However, the surpluses accumulated in the late 1930's and early 1940's were utilized under lend-lease and for wartime demands for increased quantities of food. Except for the availability of these stocks, agriculture might have suffered even greater wartime dislocations.

The stocks accumulated in 1948 and 1949 dampened the Korean boom and lessened the admittedly severe dislocations which occurred at that time. *A good case can be made that the longer-run as well as the short-run effects of the program for the years 1933 through 1951 were beneficial to agriculture and to the entire economy.*

This leaves only the years 1952 to date for further evaluation.[1] Price supports have not resulted in increased production of the basic commodities since 1952. Using 1952 as a base (or 100), the output of basic commodities was below 100 in every subsequent year until 1958, when it reached 103. On the other hand, the output of nonbasics moved up to 103 in 1953, 109 in 1954, and 123 in 1958, according to preliminary estimates. Acreage allotments and the soil bank program did hold production of the price supported crops in check.

Although the farm program probably increased total farm output somewhat during these years, the influence on output must have been relatively small. The estimates of annual increases in income for these years appear to be on the conservative side taking into consideration the points raised by Hamilton.

Admittedly these annual gains in income associated with stock accumulations may be partially offset if and when these stocks are returned to commercial markets. However, between $1 and $2 billion of farm products have been distributed outside commercial channels in each of the last 4 years. It seems probable that these programs will be continued.

Undoubtedly a part of the recent gains in income will be offset by the adverse effects of carrying forward excessive stocks. However, these will probably be minimized by future legislation and they could largely have been avoided by appropriate administrative and legislative actions.

[1] The articles by Brandow and Hathaway which appeared in the previous issue, *Journal of Farm Economics*, May 1959, tend to confirm the conclusions reached in my earlier article and supplement the brief summary statements in the subsequent paragraphs.

A NOTE ON THE ESTIMATION OF LONG-RUN ELASTICITIES

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A RECENT paper by Nerlove and Addison[1] presented some results of estimating long-run elasticities of supply and demand. I wish to confine this comment to the demand analyses, for it is here that I fear the authors' interpretation is at fault.

In the context of demand, the main assumptions of the authors' method are (a) that for every period of time there exists an equilibrium quantity

* I am indebted to a close association with the Department of Applied Economics of the University of Cambridge; in particular to Mr. J. A. C. Brown for useful discussions on this topic and to Dr. L. J. Slater for help with computing.

[1] M. Nerlove, and W. Addison, "Statistical Estimation of Long-run Elasticities of Supply and Demand," *Journal of Farm Economics*, Vol. 40, November, 1958, pp. 861-880.

demanded per unit of time which is a function of the current price of the commodity and the current income of consumers and (b) that during every period consumers adjust their current consumption towards this equilibrium by a constant proportion of the discrepancy between the quantity consumed in the previous period and the current equilibrium quantity. As a test of these assumptions the authors chose the annual observations on prices, quantities, and incomes for the United Kingdom over the period 1920-1938 given by Stone[2] and Prest,[3] and fitted to these observations a regression equation involving assumptions (a) and (b). For commodities that show "elasticities of adjustment" significantly different from unity the authors conclude that the data are consistent with their hypotheses and hence that the long-run elasticities of demand with respect to price and income are significantly different from the short-run elasticities.

I wish to discuss two issues, both of which raise doubts about the extent to which long-run elasticities of demand differ from short-run elasticities, if at all, for the type of commodity considered in the paper.

First, an issue concerning aggregation of commodities which may be brought into focus by considering the great contrast between the supply analyses and the demand analyses in this regard. The supply analyses concern highly disaggregated commodities[4] whereas the demand analyses concern broad categories[5] where many commodities have been aggregated. The importance of the effect of aggregation is recognized by the authors since they find that the estimated "elasticity of adjustment" for the group All Foods is lower than the estimated "elasticities of adjustment" for eight of the ten component food commodity groups. However this is not the full story on aggregation for it seems that further disaggregation of commodity groups reveals similar but more startling effects.

The following results go part of the way in demonstrating these effects.

An analysis of Stone's data for the United Kingdom for 25 individual commodities was made using a regression equation containing the same variables as the Nerlove and Addison equation.[6] This analysis was mainly concerned with testing the hypothesis that the lagged quantity consumed

[2] R. Stone, and others, *The Measurement of Consumers' Expenditure and Behaviour in the United Kingdom, 1920-1938*, Vol. 1, Cambridge, 1954.

[3] A. R. Prest, "National Income of the United Kingdom, 1870-1946" *Economic Journal*, Vol. 58 (1948), pp. 31-62.

[4] Twenty different types of vegetables—going so far as to distinguish between "Green Lima Beans" and "Green Snap Beans."

[5] Ten groups of foodstuffs; alcoholic drinks; tobacco products; and the category "all foods."

[6] Nerlove and Addison expressed quantities as per head of population and used Prest's income data whereas I expressed quantities as per equivalent adult and used total consumer expenditure instead of income.

variable may be used in the regression equation, instead of a time variable, to take up the effects of changes in tastes. The analysis showed that the main effect of the inclusion of the lagged variable was in bringing the estimated income elasticities more into line with *a priori* expectations–significantly negative ones becoming non-significant and extremely high values reduced to more modest levels. There was little effect on the estimates of the price elasticities. Estimates of the "elasticities of adjustment" for these 25 commodities are shown in Table 1, together with those calculated by Nerlove and Addison for 13 broad commodity groups.

Only seven commodities have "elasticities of adjustment" significantly different from unity. Despite the fact that a considerable number of commodities have not been analysed, the impression is that for most individual commodities demand "elasticities of adjustment" are *not* significantly different from unity, and hence for these commodities long-run and short-run elasticities are not significantly different.

Stone's analysis of this data should also be considered. He shows[7] that in those analyses where real income per equivalent adult, the commodity's own relative price, and time are the determining variables, only six of these 25 commodities have significant residual trend coefficients. These six are: Canned vegetables, Cocoa, Spirits, British wine, Cigarettes, and Pipe tobacco. All of these, except Spirits, appear in Table 1 with significant "elasticities of adjustment".

A test of the degree of association between trend and adjustment can be made by forming the 2×2 contingency table showing the number of commodities in each of the four categories–significant trend and significant adjustment, significant trend and non-significant adjustment, non-significant trend and significant adjustment, non-significant trend and non-significant adjustment–and making a χ^2 test of the observed cell totals against the hypothesis of no association. These totals are shown in Table 2. For this table, with Sheppard's correction, $\chi^2 = 8.8$ which, with one degree of freedom, is significant at the .01 level. Hence, for these commodities residual trend and adjustment are strongly associated.

Over the eighteen year period there were large changes in the rates of consumption per head for the five commodities with significant residual trends and significant elasticities of adjustment. At the end of the period the rates of consumption per head for canned vegetables, British wine, and cigarettes were approximately seven times, four times, and twice the rates of consumption per head at the beginning of the period; while for cocoa and pipe tobacco the rates had decreased by approximately one third. Relative prices moved for the most part in the *same* direction as consumption and income increased by only a modest twenty per cent. In these circumstances it is logical to regard these large changes

[7] Tables 106 and 110 of the reference cited in footnote 2.

TABLE 1. DEMAND ELASTICITIES OF ADJUSTMENT: UNITED KINGDOM, 1921–38

Commodity Group and Commodity	Elasticity of Adjustment	
	(1)	(2)
1. Bread and cereals	.79	—
Flour	—	a1.10(.15)
Bread	—	a1.12(.19)
2. Meat poultry and eggs	.41	—
Home beef	—	.35(.20)
Imported beef	—	a .72(.20)
Canned meat	—	a .77(.21)
3. Fish	a1.00	—
Canned fish	—	a1.26(.21)
4. Dairy products	.32	—
5. Margarine and other fats	.28	—
Margarine	—	a .60(.25)
6. Vegetables	.36	—
Home potatoes	—	a .87(.12)
Imported potatoes	—	a .97(.22)
Dried vegetables	—	a1.11(.15)
Canned vegetables	—	.04(.18)
7. Fruit and nuts	.33	—
Home apples	—	a1.10(.19)
Imported apples	—	a .70(.23)
Oranges	—	a .88(.23)
Bananas	—	a1.09(.16)
Dried fruit	—	a1.41(.21)
8. Sugar, chocolate and confectionery	.95	—
Sugar	—	a1.01(.20)
9. Tea, coffee and cocoa	.35	—
Tea	—	.45(.17)
Coffee	—	a .62(.24)
Cocoa	—	.33(.18)
10. Other foods	.15	—
11. All foods	.29	—
12. Alcoholic drinks	.89	—
Spirits	—	a .66(.22)
Imported wine	—	a .88(.23)
British wine	—	.32(.15)
13. Tobacco	.19	—
Cigarettes	—	.21(.05)
Pipe tobacco	—	.26(.14)

(1) From M. Nerlove, and W. Addison, "Statistical Estimation of Long-run Elasticities of Supply and Demand," *Journal of Farm Economics*, Vol. 40, November, 1958. Table 1, p. 869.
(2) From D. S. Ironmonger, "A method of allowing for changes in tastes in estimating elasticities of demand from time series," paper read to the University of Cambridge Economics Research Students' Seminar, 4th February, 1959. Standard errors are shown in parentheses.
a. Insignificantly different from one at the .05 level.

in the rates of consumption as being mainly due to changes in the preferences of consumers for these commodities. These changes in aggregate preferences may have been caused by many factors—e.g. the entry of women into the cigarette smoking population, an increase in the proportion of women working in industry leading to an increased preference for prepared foods such as canned vegetables, a change in fashion regarding pipes for smoking, an increase in the advertisement of British wine, etc. These and many other similar changes are given the generic name "changes in tastes." Where changes in tastes are particularly strong and steady the regression techniques will show up either a strong residual trend or a strong elasticity of adjustment.

In summary then it appears that the apparent differences between the long-run and the short-run elasticities of demand for the commodity groups examined by Nerlove and Addison are due to changes in tastes for a few of the individual commodities making up these groups.

TABLE 2. ASSOCIATION BETWEEN TREND AND ADJUSTMENT

Elasticity of Adjustment	Residual Trend Coefficient		Total
	Significant	Non-Significant	
Significant	5	2	7
Non-significant	1	17	18
Total	6	19	25

For my second issue, I wish to discuss the frequency with which consumers adjust their rate of consumption.

Since the decisions regarding how much of which crops to plant are often made at yearly intervals and when carried out cannot be adjusted until the following season, it may be satisfactory on the supply side to have a model of farmers' behavior based on periods of one year. The testing of the hypotheses embodied in such a model by *annual* measurements of acreages, prices, etc. should be straightforward since the "natural" period of adjustment is an annual one. However, for consumers, decisions regarding how much of which commodities to consume can be and are made more frequently than once a year. Adjustments to the rates of consumption can be made at monthly, weekly, or even daily intervals. Any model of consumers' behavior based on periods of one year should be taken as only an approximation to some continuous process or at least as an approximation to a discontinuous process with periods as short as a month. The specification of a dynamic model of consumers' behavior for testing by *annual* measurements involves particular difficulties since the

"natural" period of adjustment, if it exists, is probably very much shorter than a year.

Whilst it is difficult to reject the hypothesis that consumers have some lag in the adjustment of their demand to changes in prices and income, the fact is that these lags must persist for a very long time for values of the "elasticity of adjustment" of less than 0.5 to be obtained from *annual* measurements of incomes, prices and quanities consumed. These values imply that *monthly* observations should give values of the "elasticity of adjustment" considerably less than 0.5.

The equations in the model involve flows of commodities per unit of time, income flow per unit of time, and prices. If the flows are measured at an instant of time there is an exact relationship between the "elasticities of adjustment" for intervals of time of various length. For example, if a is the annual elasticity and m is the monthly elasticity, then a and m are connected by the relation $1 - a = (1 - m)^{12}$ so that if $a = 0.33$, $m = 0.0332$. . . . However the available statistics are not measurements of flows at instants of time but are annual averages of the instantaneous flows and prices. With these measurements the annual "elasticities of adjustments" do not lead to any exact values for monthly (or quarterly etc.) "elasticities of adjustment."

The difficulty with the adjustment concept when it is applied to flows measured as averages for period may be seen from the following example. If a monthly adjustment of 0.1 is carried out for three months the quarterly adjustment will be 0.187, and if continued for a further nine months the annual adjustment will be 0.3785. On the other hand, if a quarterly adjustment of 0.187 is carried out for four quarters the annual adjustment will be 0.3379.

Annual "elasticities of adjustment" of approximately one-third were obtained by Nerlove and Addison for six commodity groups. For these groups the authors' estimates imply that consumers adjust their consumption in any month by approximately one-tenth of the discrepancy between the previous month's consumption and the current month's equilibrium. This seems to be an exceedingly slow rate of adjustment. From observations of weekly and monthly fluctuations in prices of consumer goods and the quantities of these goods consumed there is evidence that consumers react fairly quickly to price changes.

For this evidence we need go no further than the paper by Berry, Brinegar and Johnson[8] in the same issue of the *Journal of Farm Economics*. They present the results of an experiment where skim milk prices

[8] C. H. Berry, G. K. Brinegar, and S. Johnson, "Short Run Effects Following Controlled Price Changes: Skim Milk," *Journal of Farm Economics*, Vol. 40, November, 1958, pp. 892-902.

were varied at two-monthly intervals for four years and daily sales recorded. Although the maximum adjustment of consumption of skim milk was attained at approximately 5 to 6 weeks after the price disturbance, thereafter remaining more or less constant, almost all of the adjustment took place within the first two weeks after the price disturbance.

Further evidence regarding the extent of the inertia in consumers' response to price changes is contained in a recent paper by Brown.[9] He shows that for butter over 80 per cent of the response of demand to a price change occurred within the current month and for margarine (in response to the price of butter) almost 70 per cent.

The existence of some inertia in the response of consumers to changes in prices and income is not disputed. That this inertia is sufficient to explain the long-run trends in the consumption of food, drink and tobacco is.

In the context of demand, this note has advanced two propositions: (a) the data used by Nerlove and Addison support at least as well an alternative hypothesis to their lagged adjustment hypothesis; and (b) additional evidence suggests that consumers respond much more quickly than the response attributed to them by the authors. In these circumstances it seems preferable to regard the observations of consumers' behavior in regard to food, drink and tobacco as confirming the alternative hypothesis of the occurrence of changes in tastes.

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[9] J. A. C. Brown, "Seasonality and Elasticity of the Demand for Food in Great Britain Since Rerationing," *Journal of Agricultural Economics*, vol. 13, June 1959.

ON THE ESTIMATION OF LONG-RUN ELASTICITIES: A REPLY

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IRONMONGER'S penetrating comment on some recent results obtained by Addison and myself, brings out several problems in the estimation of long-run elasticities of demand worthy of further discussion. Rather than take issue with his specific results, which form a useful supplement to our work, I shall comment on the implications of some of the problems which he raises.

1. *Aggregation Over Commodities*

The problem of aggregation has always plagued economic statisticians; analysis of long-run demand is no exception to this rule. Ironmonger finds that when some of the broad commodity groups are broken down and the components subjected to an analysis similar to that for the broad groups,

substantially higher elasticities of adjustment are obtained for the component items. It is possible to show that provided the same general relation holds between the microvariables as between the macrovariables (or aggregates), the elasticity of adjustment need not be any simple weighted average of the elasticities of adjustment for the component items. For example, let q_{it} = the current quantity demanded of the ith commodity, p_{it} = the current price of the ith commodity, and y_t = the current income of consumers. Consider the estimating equation for the ith commodity corresponding to the type of equation used in our study:[1]

$$(1) \qquad q_{it} = a_i\gamma_i + b_i\gamma_i p_{it} + c_i\gamma_i y_t + (1 - \gamma_i)q_{it-1} + u_{it}$$

where a_i, b_i, and c_i are coefficients in the long-run demand equation for the ith commodity, γ_i is the coefficient of adjustment appropriate to the ith commodity, and u_{it} is a randomly distributed residual term.

Now consider the demand for an aggregate commodity where the aggregates are simple sums of the component items:

$$(2) \qquad \begin{cases} q_t = \sum_i q_{it} \\ p_t = \sum_i p_{it} \end{cases}^2$$

Income is the same as before. Our aggregate estimating equation is similar to equation (1) above.

$$(3) \qquad q_t = a\gamma + b\gamma p_t + c\gamma y_t + (1 - \gamma)q_{t-1} + u_t$$

(3) involves a single price, income and lagged quantity, but refers to the broad commodity group rather than the components.

What is the relation between the coefficients, a, b, c, and γ of the aggregate equation and the coefficients a_i, b_i, and γ_i; of the equations for the component items? Theil has shown that the coefficients a, b, c, and γ, or *macroparameters* as he calls them, are not simple weighted averages of the coefficients a_i b_i, c_i and γ_i or *microparameters*.[3] Consider a set of least-squares regressions, each of the component indices, q_{it-1}, p_{it}, and y_t on the aggregate indices, q_{t-1}, p_t, and y_t:

$$(4) \qquad \begin{cases} p_{it} = A_{1i} + B_{1,1i}p_t + B_{2,1i}y_t + B_{3,1i}q_{t-1} + V_{1it} \\ y_t = y_t \\ q_{it-1} = A_{3i} + B_{1,3i}p_t + B_{2,3i}y_t + B_{3,3i}q_{t-1} + V_{3it} \end{cases}$$

[1] Marc Nerlove and William Addison, "Statistical Estimation of Lon-Run Elasticities of Supply and Demand," *Jour. Farm Econ.*, Vol. 40 (November, 1958), equation (3), p. 864.

[2] Stone's data, it should be noted, are of exactly this type, i.e., the components sum to the aggregates. Though neither Stone, we, nor Ironmonger have dealt with linear relationships, the analysis below is considerably simplified by this assumption. The simplification does not affect the qualitative conclusions which are drawn.

[3] H. Theil, *Linear Aggregation of Economic Relations* (Amsterdam: North Holland Publishing Company, 1954). Theorem I, pp. 13-15.

The identity $y_t = y_t$ is included only for the sake of completeness and symmetry. Theil shows that the coefficients in equations (4) determine the relation between the least-squares estimates of the microparameters of (1) and the least-squares estimates of the macroparameters of (3).

In particular, we are interested in the reason for the small elasticities of adjustment for the broad commodity groups as compared with the elasticities of adjustment for the component items. While the statistical analyses are in logarithmic terms rather than strictly linear, Theil's analysis offers an approximate explanation. The theorem of Theil's referred to above can be used to show that the least-squares estimate of γ, $\hat{\gamma}$, is equal to the following combination of the coefficients in (4) and the microparameters, b_i, c_i, and γ_i:

$$\hat{\gamma} = \sum_i B_{3,3i}\gamma_i - \sum_i B_{3,1i}b_i - \sum_i B_{3,2i}c_i. \tag{5}$$

If we are primarily interested in the microelasticities of adjustment, then a microelasticity of adjustment corresponding to a simple weighted average of the microelasticities would appear to be desirable. Given the assumption that the macro- and microrelations are of the same form, it is clear that the aggregate elasticity of adjustment will not be a simple weighted average of the component elasticities if there are divergent movements among the components q_i of the aggregate q. If the q_i moved exactly in proportion to q, the coefficients $B_{3,3i}$ in (4) would measure the contribution of each q_i to the aggregate index q; hence, the first term on the right hand side of (5) should be essentially the sort of weighted average we think may be desirable. If the indices move divergently, different component elasticities of adjustment tend to receive weight disproportionately, higher weight going to those components moving most divergently. The reader can easily construct examples in which divergent movements of components cause an estimated aggregate coefficient or elasticity of adjustment to differ markedly from any reasonable weighted average of the component elasticities of adjustment.

Equation (5) shows that the estimated elasticity of adjustment also depends on the price elasticities of demand for the component items. By virtue of the fact that $y_t = y_t$, i.e., the income variables are identical in the aggregate and component analyses, $B_{3,2i} = 0$ for all i and the third term on the right hand side of (5) vanishes. We are left only with the second-term. Since we are dealing with demand, the b_i are typically negative. If, for the moment, we neglect the divergencies in movement among the q_i and bear in mind that the b_i are negative, it is clear that the estimated aggregate coefficient or elasticity of adjustment, γ, is greater or less than a weighted average of the γ_i according as the $B_{3,1i}$ are positive or negative. In our case they appear to be negative.

Thus, provided the macro- and microrelations are of the same form, the estimated macroelasticity of adjustment differs from a weighted average of the microelasticities because of divergent movements in the component quantities q_i and because of the dependence of the macroelasticity of adjustment on the individual price elasticities of demand. In this sense, Ironmonger's finding does substantiate his conclusions that the aggregate elasticities of adjustment do not present a true picture of the underlying microelasticities of adjustment. However, there is one point which may vitiate his further conclusion that the elasticities of adjustment for the aggregates should really be higher, i.e., that we should really derive them as weighted averages of the component elasticities and so find them larger and perhaps nearly equal to one.

The point is simply that microrelations of the same form and including the same variables as the macrorelation are not necessarily appropriate for the analysis of component items. First, we might expect that the demand for a particular commodity will depend much more on the prices of closely related commodities than will the demand for a broad aggregate. For example, the demand for home beef is much more closely related to the prices of imported beef, canned beef, pork, and mutton than is the demand for all meat, poultry and eggs to the prices of dairy products or fish. The microanalyses which Ironmonger presents are of exactly the same form and include the same variables as do our macroanalyses, i.e., own price, income, and lagged quantity. Both the high level and lack of significant difference from unity of the estimated microelasticities of adjustment may be due to the fact that variables, especially other prices, are left out of these analyses. The macroelasticity, on the other hand, may be little affected by the exclusion of appropriate variables, since closely related items have in general been included in the same category.[4] On the basis of this reasoning, Ironmonger's finding that the microelasticities are substantially higher on the whole than the macroelasticities does not show that the macroelasticities are necessarily the ones in error.

Suppose, however, we accept the finding that the microelasticities of adjustment are closer to one than the macroelasticities. Is this really inconsistent with the idea that long-run elasticities differ from short-run? The distinction between long- and short-run demand derives mainly from the idea that consumers' habits are somewhat ingrained and take time to change and partly from the idea that time is required to find substitutes for a commodity whose price has risen. Both of these rationales operate quite differently when applied to a narrowly specified commodity than when applied to a broad commodity group. Clearly, less of a wrench to a consumer's habits will be required for a shift from consumption of im-

[4] But not always; see Nerlove and Addison, *op. cit.*, footnote 25, p. 870.

ported beef to home produced beef than for a shift from all meat to cheese or fish. Furthermore, the more narrowly specified a commodity the easier and less time-consuming it will be to find substitutes for it when its price rises relative to other prices or to substitute it for other commodities when its price falls. On both counts, therefore, we might expect the elasticity of adjustment to be lower for a broad commodity group than many, if not all, of the elasticities for the component items of the group. All this is just another way of saying that the form of the microrelations is not likely to be the same as the form of the macrorelation; aggregation significantly alters the character of the required statistical analysis.[5]

Ironmonger's findings are, of course, entirely consistent with the last mentioned point. Consequently, although we must recognize the value of the sort of disaggregation he suggests and the worth of investigating the relation between micro- and macroelasticities of adjustment, I cannot agree with him that the macroelasticities which Addison and I have found are necessarily in error.

2. *Aggregation Over Time*

Ironmonger points out that our estimates of the elasticities of adjustment are unreasonably low in view of recent findings by Brown and by Berry, Brinegar, and Johnson. Although these findings refer to rather more narrowly specified commodities than our broad commodity groups, and are therefore open to objections similar to those raised above, there is considerable merit in Ironmonger's attempt to compare the two sets of results. The analysis of the effects of aggregation over time is more difficult than that given for aggregation over commodities. However, it can be shown that low elasticities of adjustment for temporal aggregates need not imply low elasticities of adjustment in analysis which are based on data for shorter intervals, of time, although, of course, the latter are the more "correct."

Rather than give a formal analysis as given in the preceding section, which is quite difficult in the case of aggregation over time, I shall merely indicate by means of numerical examples why the elasticity of adjustment obtained for annual data need not correspond in the way Ironmonger suggests to that obtained for shorter periods, say quarters. The estimating equation (3) is derived actually from two equations: the long-run demand function

$$\bar{q}_t = a + bp_t + cy_t \tag{6}$$

[5] This point has been made by Yehuda Grunfeld and Zvi Griliches in another connection in their "Is Aggregation Necessarily Bad?", unpublished paper dated September 1958.

and the adjustment equation

$$q_t - q_{t-1} = \gamma[\bar{q}_t - q_{t-1}] \tag{7}$$

where $\bar{q}_t$ is the long-run equilibrium quantity demanded. Suppose, for the sake of the example, that (6), p_t and y_t are known, and hence q_t is known, for each quarter. We may then estimate γ from the quarterly observations on q_t and $\bar{q}_t$, since by (7)

$$\gamma = \frac{q_t - q_{t-1}}{\bar{q}_t - q_{t-1}} . \tag{8}$$

Thus if demand were 100 units last quarter and equilibrium demand is 1100 units this quarter, a current demand of 600 units indicates $\gamma = .5$. Suppose, however, that instead of using quarterly data we attempt to use annual totals to estimate γ.

If the quarterly coefficient of adjustment is .5 then compounding it over the year as Ironmonger does should yield an annual coefficient of adjustment of approximately .94. Table 1 gives quarterly and annual data for the following situation: Equilibrium demand in year 1 is 100 units per quarter or a total of 400 units on an annual basis. Consumers are in equilibrium in year 1 and consume 100 units per quarter. In year 2, however, the equilibrium demand shifts to 1100 units per quarter or 4400 units on an annual basis. If $\gamma = .5$ consumers adjust so that they consume 600 units in the first quarter, 900 in the second, and so on, for a total of 3550 for the year. The estimated annual coefficient of adjustment is .78 which implies a quarterly adjustment of only .325. This is substantially lower than the "true" quarterly value of the coefficient of adjustment.

A similar numerical example can be used to show that when the equilibrium quantity falls from year 1 to year 2, a coefficient of adjustment estimated on the basis of annual totals will also understate the "true"

TABLE 1. QUARTERLY AND ANNUAL DEMAND FOR AN INCREASE IN EQUILIBRIUM DEMAND AND $\gamma = .5$

Year	Quarter	$\bar{q}_t$	q_t
1	I	100	100
	II	100	100
	III	100	100
	IV	100	100
Annual Total		400	400
2	I	1100	600
	II	1100	900
	III	1100	1000
	IV	1100	1050
Annual Total		4400	3550

coefficient of adjustment. The rationale behind both cases is clear: Because consumers do not adjust fully to a change in the conditions which determine their equilibrium position, their current demand always lags behind their equilibrium demand. Hence, for given but different equilibrium positions in each year, the coefficient of adjustment estimated from annual data must understate the "true" coefficient of adjustment. The reader can easily construct numerical examples to show that the same conclusion results if there are increasing or decreasing trends in the equilibrium demands.

When cycles occur in consecutive years in the quarterly values of equilibrium demand, it may even happen that comparison of annual totals will lead to an erroneous estimate of the annual coefficient of adjustment which is larger than one. Table 2 shows just such a cycle. The quarterly

TABLE 2. QUARTERLY AND ANNUAL DEMAND FOR A TWO-YEAR CYCLE IN EQUILIBRIUM DEMAND AND $\gamma = .5$

Year	Quarter	$\bar{q}_t$	q_t*
1	I	200	100
	II	300	150
	III	400	225
	IV	500	313
Annual Total		1400	788
2	I	400	356
	II	300	328
	III	200	264
	IV	100	182
Annual Total		1000	1130

* Note: Figures have been rounded to nearest unit.

coefficient of adjustment is .5, but the estimated annual coefficient is approximately 1.6 and highly unreasonable.

The reader can construct further numerical examples to give any desired annual coefficient of adjustment given any "true" quarterly coefficient. In those with which I have experimented, examples characterized by relatively long runs of increasing or decreasing equilibrium demand give estimated annual coefficients which imply quarterly coefficients *below* their "true" levels. On the other hand, those with fairly rapid cycles in equilibrium demand tend to give estimates based on annual data which imply quarterly coefficients *above* their "true" levels.

Since much economic data is characterized by relatively long runs of increasing or decreasing values, it is perhaps a safe generalization to say that the true coefficient or elasticity of adjustment is likely to be underestimated in demand studies based on annual data. This does not mean, however, that long-run elasticities of demand do not differ from short-run

elasticities, or that other variables such as tastes must account for our success in using lagged quantity. Rather it suggests that coefficients of adjustment in demand analyses based on annual data should be interpreted with extreme care and where possible demand analyses should be based on quarterly or even monthly data.

3. *Tastes*

Ironmonger presents an analysis of the relation between trend coefficients found in static analyses and the coefficients of adjustment found in Addison's and my dynamic analyses. He finds a strong association and concludes on the basis of this and the other evidence which he presents that changing tastes must largely account for our finding that lagged quantity is a significant variable in our demand analyses. Though Ironmonger's conclusions would have been strengthened had he used the sort of test suggested by Hotelling for selection of variables,[6] his results cannot be lightly dismissed.

It can in fact be shown that the omission of a relevant variable which is positively serially correlated does tend to bias the estimated coefficient or elasticity of adjustment downwards.[7] Tastes are just such a variable. However, the moral of this is not that there is no difference between long- and short-run elasticities but that more effort should be devoted to obtaining measures of changing tastes and using such measures in demand analyses.

4. *Conclusions*

Ironmonger has made several valuable comparisons between Addison's and my recent results and the results of other investigations. He finds that our estimated elasticities of adjustment are low by comparison with the estimates obtained by disaggregation with respect to commodities and with respect to time. The results of the comparison for disaggregation with respect to commodities are not unreasonable in view of the possibilities of aggregation bias which exist and in view of the plausible argument that elasticities of adjustment for broad groups of commodities should be lower than for individual commodities. The comparison between our annual elasticities of adjustment and those based on data for shorter periods is a more serious matter. The recent findings of Berry, *et al.*, and Brown suggest that the coefficients or elasticities of adjustment

[6] Harold Hotelling, "The Selection of Variables for Use in Prediction with Some Comments on the General Problem of Nuisance Parameters," *Annals of Mathematical Statistics*, Vol. 11 (1940), pp. 271-83. See also Gregory C. Chow, "The Selection of Variables for Use in Prediction: A Generalization of Hotelling's Solution," forthcoming.

[7] See my discussion with Brandow in the *Jour. Farm Econ.*, Vol. 40 (August 1958), pp. 719-28.

obtained from annual time series may be seriously in error. Two numerical examples presented above appear to indicate that estimated annual elasticities of adjustment will tend to be lower than the "true" values. In view of the discussion presented above, however, Ironmonger's final conclusion that ". . . it seems preferable to regard the observations of consumers' behavior in regard to food, drink and tobacco as confirming the alternative hypothesis of the occurrence of changes in tastes," does not appear to follow from his evidence.

SOURCES OF PROFIT AND DECISION MAKING IN CATTLE FEEDING

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ATTEMPTS are frequently made to divide the returns from a cattle feeding operation into shares identified with certain causal factors. The purpose of this note is to show that such division of returns is (1) based on arbitrary accounting conventions and (2) is irrelevant in terms of an elementary production economics model.

The choice of the accounting convention to be invoked should be determined by the decision model assumed to characterize the person for whom the division of returns is performed. Establishment of a relationship between an accounting identity and the planning procedure is a necessary condition for demonstration of the utility of the identity in decision making.

In the immediately following presentation, we first define the accounting quantities, then write the basic identity from which identities showing various divisions of returns are subsequently developed. None of the identities presented are relevant to the simple production model presented in the second section of this note.

Accounting Identities

For illustration, let us deal with the situation in which interest lies in return above the purchase cost of the animal and feed cost.

Using the following notation

R = returns above purchase price of animal and feed cost
W_b = beginning weight (pounds)
W_s = selling weight (pounds)
P_b = purchase price (dollars per pound)
P_s = selling price (dollars per pound)
C = feed cost (dollars per pound of gain)

we may write the accounting identity:

$$R = W_s P_s - W_b P_b - (W_s - W_b)C \tag{1}$$

We now illustrate how algebraic manipulation of (1) leads to various types of "divisions" of returns above purchase and feed cost. By adding $W_b P_s - W_b P_s = 0$ to the right hand side of (1), we, of course, do not change the fact that this is an accounting identity. By making such an addition and collecting terms, we get

$$R = W_b(P_s - P_b) + (W_s - W_b)(P_s - C) \tag{2}$$

The first term on the right hand side has been called "gain per head on price spread" and the second term "return due to feeding margin." Identity (2) is the usual division of returns into "sources."[1]

By adding $W_b P_s - W_b P_s + W_b P_b - W_b P_b + W_s P_b - W_s P_b = 0$ to the right member of (1) and collecting terms, we get

$$R = W_b(P_s - P_b) + (W_s - W_b)(P_s - P_b) + (W_s - W_b)(P_b - C). \tag{3}$$

The first term on the right hand side of the identity might be termed "return per head from price spread on original weight," the second term, "return per head from price spread on gain," and the third term, "return per head from feeding margin." This division appears no less arbitrary than that of (2) above.

A third division of returns may be accomplished simply by prorating the return R into the following two parts:

$$R = \left[\frac{W_b}{W_s}\right] R + \left[\frac{W_s - W_b}{W_s}\right] R \tag{4}$$

The first term on the right hand side of (4) represents the "share" of return "attributed" to beginning weight while the second term represents the "share due" the gain.

Clearly, one could continue to manipulate (1) and obtain a wide variety of "divisions" of the return. The point is simply that in order to evaluate the usefulness of empirical data (either collected from farmers or obtained from controlled experiments) in terms of helping farmers make economic decisions it is necessary to specify the model assumed to characterize the decision process of the cattle feeder. It is believed that no decision model has been specified in the literature for the common division

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[1] Raymond R. Beneke, *Managing the Farm Business*, John Wiley and Son, New York, 1955, p. 218.
H. C. M. Case, and P. E. Johnston, *Principles of Farm Management*, Lippincott, Chicago, 1953, p. 151.
E. O. Heady, and H. R. Jensen, *Farm Management Economics*, Prentice-Hall, New York, 1954, p. 284.
A. G. Mueller, and D. F. Wilken, "How to Pick Your Feeding System," *Capper's Farmer*, October, 1957, pp. 32-33.

of returns (2) which appears in elementary text books. Consequently it is difficult to see the purpose of this imputation procedure.

A Simple Economic Model

The following exposition attempts to employ essentially the same variables as presented above. Our chief purpose is to show that it *does not* require the "division" of returns as frequently done by farm accountants. Further, it is not likely that making the model more complex would require such imputation of returns to "sources."

In this model, we assume that the decisions are broken into two phases: the pre-purchase and the post-purchase. In a sense, the first deals with choice of the system and the second the level of feeding within the system. Of course, these two are related, and in our model we assume that the pre-purchase decision is based on the usual or customary practices concerning feeding methods within the system.

Suppose that only two systems are considered—calves and yearlings. A simple break-even analysis may be employed to analyze this choice. In terms of (1) we wish to determine the relationships between the selling price of finished calves, P_{sc}, and the selling price of finished yearlings, P_{sy}, necessary to obtain the same returns from each system. This means that we consider this relationship to be the most uncertain in prospect and that the other variables in (1) can be rather accurately estimated at the time of choice of system.

Break-even returns may be calculated on several bases. Consider first that interest lies in the relationship between selling prices of finished calves and finished yearlings necessary to give the same return *per head* for each system. Assume that the purchase price per pound for calves, P_{bc}, is 26 cents per pound and for yearlings, P_{by}, 25 cents per pound. It is convenient at this point to separate C, the feed cost per pound of gain into its physical and price components. (This separation is necessary for the post-purchase decision discussed below.) Let X equal the pounds of T.D.N. fed per animal and P_x equal the price per pound of T.D.N. and assume that the T.D.N. is 3.5 cents per pound.

We then equate the returns above feed and purchase price of the animals for the two systems:

$$W_{sc}P_{sc} - W_{bc}P_{bc} - X_cP_x = W_{sy}P_{sy} - W_{by}P_{by} - X_yP_x$$

Using the data in Nelson's study[2] on beef production as a basis for selecting starting and finishing weights and feed consumption for each system, we may substitute in the above relation.

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[2] Aaron G. Nelson, Relation of Feed Consumed to Food Products Produced by Fattening Cattle. U.S.D.A. Tech. Bul. 900. September 1945. Tables 9 and 11, pages 29 and 31.

$$1000P_{sc} - (400)(26.0) - (3,328)(3.5) = 1040P_{sy} - (640)(25.0) - (2,436)(3.5)$$

or

$$P_{sc} = 1.04P_{sy} - 2.48$$

If, for example, the expected selling price for finished yearlings is 25 cents per pound, finished calves would have to sell for at least 23.52 cents per pound in order to return as much *per head* as the yearlings. The comparison of per head returns might be applicable if, for example, there is a fixed set of equipment and buildings which can handle the same number of animals in either system.

If the supply of funds for purchase of animals and feed is the limiting element determining size of enterprise, the system may be chosen on the basis of return *per dollar spent* on the feeder and the feed. Thus the break-even analysis would be based on the following relation:

$$(1000/220.48)P_{sc} = (1040/245.26)P_{sy}$$

or

$$P_{sc} = .935P_{sy}$$

The selling price per pound of finished yearlings would need to be more than 93.5 per cent of that of the finished calves in order to make the yearlings the more profitable system. Needless to say, the break-even price differential depends on the assumption concerning the limiting resource. A set of limiting resources, as well as inter-relationships with the cropping system may be considered by use of the linear programming technique.

Assuming that a particular type and weight of feeder has been chosen, several alternatives exist for management prior to sale of the finished animal. This type of decision constitutes the second phase in our analysis. Various levels of winter feeding combined with variations in use of pasture for summer feeding may constitute important alternatives. In the following analysis, we consider only the level of feeding over the entire period. Ideally, production functions for various sub-periods would be needed to analyze the relative profitability of such problems as the choice of feeding rates of grain in winter and summer.

Choice of the optimum selling weight will serve to illustrate a type of decision made *after* the system has been selected and the feeders purchased. It will be recalled that a typical selling weight for the system was used as the basis for computing gross returns in the process of selecting the system. As the feeding period progresses, however, better estimates may be made of the selling price. Using a total period production function for calves such as that reported by Nelson,[3] one can apply conventional methods of determining an optimum selling weight. For calves the reported function is

$$W_{sc} = 1446 - 1049e^{-0.000257x}$$

[3] Nelson (p. 27).

Optimum selling weight would be indicated by choosing X so that

$$\frac{dW_{sc}}{dX} = -\frac{P_x}{P_{sc}}$$

that is, that marginal value product equals marginal cost of feed.

Concluding Remarks

The simple economic model presented above was restricted to those variables which have traditionally been used in an accounting analysis of cattle feeding. The addition of the technical relation between feed and gain has permitted a simple economic analysis. Investigation is needed to determine if these variables are sufficiently relevant to be useful. Further, the model treats uncertainty by simply permitting the postponement of one decision. An empirical investigation may show that uncertainty considerations related to other aspects of the farm business (e.g. production of feed supplies) may be as important as the uncertainty stemming from the market phenomena as emphasized in the model presented. The attempt in this note, however, was simply to indicate that the conventional division of returns in cattle feeding is arbitrary and does not appear to be relevant to a simple economic model.

PROJECTIVE TECHNIQUES: POTENTIAL TOOLS FOR AGRICULTURAL ECONOMISTS?*

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ONE OF the current difficulties facing those doing research on the problem of agricultural adjustment is how to measure nonmonetary individual and group variables. Most researchers recognize the difficulty of gathering valid data even when there is a concrete empirical referent for concepts. However, it is when attempts to measure needs, values, attitudes and feelings are made that extreme difficulty is encountered in gathering valid data. And yet, many theoretical models call for the measurement of these variables in order to test theory.

The authors believe that projective techniques may offer some potential in this area of measurement.

Projective techniques[1] over the past three decades have been an essen-

* Journal Paper No. J-3572 of the Iowa Agricultural and Home Economics Experiment Station, Ames, Iowa. Project No. 1236. The present study was made possible by a grant from the Foundation for Research on Human Behavior, Ann Arbor, Michigan.

[1] For a more complete introduction to projective techniques see Harold H. Anderson and Gladys L. Anderson, *Projective Techniques*, N.Y. Prentice-Hall, 1951.

tial tool in the kit of many clinical psychologists. The use of projective methods by the social scientist in field research is still exploratory and tentative.

The term "projective techniques" is used to describe a wide range of measuring devices including the Rorschach Ink Blot Test, Thematic Apperception Test (TAT), stimulus pictures, cartoon-like projectives, drawing-a-human figure, word association, and sentence completion.

The projective method is usually used to refer to those types of measurement in which subjects are asked to respond to nonstructured or ambiguous stimuli. The task of the subject is to organize, give meaning to, and interpret the stimulus situation which has no inherently compelling organization. The basic assumption of these techniques is that the respondent's imposition of interpretation, meaning, and structuring on the stimulus situation will give valuable insights into the respondent's values, attitudes and feelings, and reactions to people and things.

The "projective" aspect of the method implies that the subject will project himself into the stimulus situation and then interpret and structure the situation on the basis of his past experiences. The respondent is not asked to assess his own personality or personality traits but to provide data upon which such an assessment can be made.

The claim is made, which in some cases is validated by research, that the respondent will provide more valid data, a greater depth of data, and in some cases actually provide data that he is not willing to divulge or does not consciously recognize as being a part of his basic personality structure. It is believed that it is much more difficult for the respondent to "fake" projectives.

Many of these techniques are described as "disguised" techniques[2] in the sense that they provide opportunity to probe into the subject's predispositions without his being aware of the specific intent of the research instrument. In order to disguise the investigator's purpose, some techniques are used which enable the subject to reveal his needs and values through the medium of another person or fictional character, with whom the subject may be presumed to have some degree of identity. The theory behind this approach is that the subject is more likely to express feelings uninhibitedly through the mask of the third person or created character than directly in the first person. It would be an oversimplication, however, to assume that one can always directly infer the characteristics of the subject from the values, attitudes, motivations, and emotions imputed to the character with whom he empathizes.

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[2] Murray A. Straus, "Direct, Indirect and Disguised Measurement in Rural Sociology," Pullman, Washington Agricultural Experiment Station Technical Bulletin 28, 1957.

Three types of projectives are currently being used by the authors: stimulus picture, cartoon-like projective, and sentence completion.[3]

One type of projective technique is the *stimulus picture*. It is a line drawing which is suggestive of a certain situation but where the specific details (such as facial expressions) are missing. The interviewer encourages the respondent to describe what is going on in the picture and how he thinks the pictured characters feel about and perceive different objects and relationships.

It is obvious that most stimulus pictures (see an example in Figure 1) have a degree of structuring. The choice of the characters and the physical and social situation in which they are shown is structuring. Additional structuring can be introduced by the type of questions asked. For example, in the case of the present study, comparable data from all respondents on certain important variables were desired. Additional structuring of the interview situation was obtained by asking a specific set of "probe questions" of each respondent. Of course, additional questions were asked as the situation suggested significant leads.

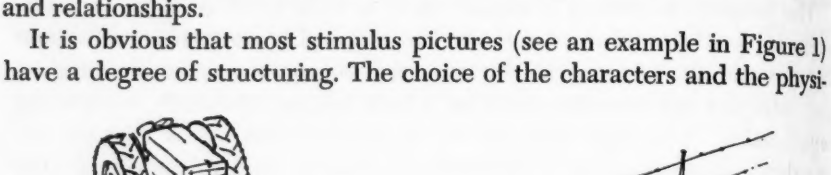

FIG. 1. THE STIMULUS PICTURE USED IN THE PRESENT STUDY

[3] For a more complete discussion of the theory of projectives and the use and results of these three types of projectives see, George M. Beal and Joe M. Bohlen, "The Use of Projectives in Field Research," a paper presented at the Seminar for Cooperators in the TVA Agricultural Economic Research Activities, March 26-27, 1958, Knoxville, Tennessee. Copies are available from George Beal, Iowa State University.

As an example of experience with projective techniques, the present discussion will center on one of seven stimulus pictures which were recently used in two separate studies of reference group influences on adoption decisions. This particular stimulus picture was used to determine the importance of the neighborhood reference group in the adoption of new practices. Previous attempts to obtain valid data in this area with structured questionnaires were unsuccessful. The sample was drawn to insure a proportionate number of farmers from each of the adopter categories: innovators, early adopters, early majority, late majority and laggards.[4] An 8 by 11 inch stimulus picture (Figure 1) was handed to the respondent and the probe questions were asked. The field interviews took place in farmer's homes. In this particular case, all remarks were tape recorded and a content analysis was made of the interview protocol. This information furnished data that were previously unobtainable with conventional methods.[5] The following are examples of tentative generalizations reached by testing selected hypotheses.

1. The neighborhood reference group was an important influence on adoption decisions. It was ranked as important by approximately 90 per cent of the respondents.
2. No specific uniform reference norm on adoption of new ideas was perceived to exist on a neighborhood basis. Rather, the heterogeneity of individual farmer norms were emphasized.
3. The neighborhood reference group was a more important normative reference group for the majority and the laggards than for the innovators and early adopters.
4. The neighborhood constituted a comparative reference group for late majority and laggard farmers.
5. Innovators and early adopters were more likely to be oriented outside of their local neighborhood group to a friends or congeniality reference group.
6. Laggards exhibited some degree of insecurity in the neighborhood social setting in terms of competitive comparisons with other farmers.
7. Adopter categories differed as to their perception of what is discussed in the neighborhood social setting. Inovators and early adopters perceived this discussion more in terms of a direct exchange of specific

[4] For a description of this method of categorization, see: Everett M. Rogers, "Categorizing the Adopters of Agricultural Practices," *Rural Sociology* 23: 345-354, December, 1958.

[5] On the basis of limited testing there was evidence that the stimulus picture provided data that meet the generally accepted level of validity and reliability. For a more complete report on methodology and findings using seven different stimulus pictures in one study see: Everett M. Rogers and George M. Beal, "Reference Group Influences in the Adoption of Agricultural Technology," Ames, Iowa State Univeristy Department of Economics and Sociology Mimeo Report, 1958.

technical information. The late majority and the laggards perceived the topics discussed more in terms of a social visit where general farming problems and the weather are discussed and technical farming information is approached on an indirect basis.

8. There were two related propositions regarding the attitude of neighbors to an innovator within the neighborhood group: (1) superficially, innovators within a neighborhood group were depreciated by other neighborhood group members. Such remarks as the following about the "neighbor's attitudes" supported this generalization: "They'd feel he was wasting money," "make fun of him," "laugh at him," "there is always somebody like that," "scoff good naturedly," "you can be *too* early," "think he's crazy," "they'd be skeptical," and "they might criticize him"; and (2) there was a basic appreciation on the part of neighborhood group members for the innovator. The following remarks, often given by the same people quoted above, gave this indication: "They'd respect him for going ahead," "go along with it if it worked," "anxious to see if it works," "think he's progressive," "obliged to him for trying it," "like to see it tried," and "if it worked they'd try it next year."

In summary, on the positive side, the use of stimulus pictures and other projective techniques have demonstrated a potential for obtaining "hard-to-get" data related to such areas as values, beliefs, and norms. They provide a means of obtaining data that the respondent is not otherwise willing to divulge or does not consciously recognize. Farmer respondents accept the use of projectives in field research; to date no refusals have resulted from the use of these types of projectives. They may be used in combination with probe questions or as a part of direct questionnaire schedules. When used as a part of a formal schedule, they have been found to be rapport builders and to relieve interviewee fatigue. On the side of limitations: it takes much time, thought, money and competent artists to produce stimulus pictures for specific purposes; there is less control over the interview situation and the specific data obtained; and there is the problem of precisely conceptualizing and quantifying the data obtained. Valid results from projective techniques can be obtained only in the hands of skillful and trained social scientists.

Our experience with projective techniques suggests that they may be a potential tool for research workers in agricultural economics.

USE OF MODIFICATION VECTORS IN ADJUSTING LINEAR PROGRAMMING SOLUTIONS*

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LINEAR programming has come to be recognized as a useful medium for farm planning. This method of analysis lends itself to problems of farm management involving enterprise choice, profit maximization, of cost minimization. In addition to the usual type solutions that are forthcomig from the linear programming process, researchers have developed many "by-products" and "short-cuts."[1]

The purpose of this note is to illustrate how modification vectors have been used in farm planning. More specifically the authors will illustrate:

(1) The use of a vector in a linear programming model for determining the changes in resource organization on a farm with dairy cows of various levels of milk production.
(2) The use of a vector in a linear programming model for determining the crop yield increases required to pay for a particular management practice.

Data for these examples are from a model used in planning a dairy farm in southeastern Pennsylvania. The objectives in planning this dairy farm were to determine the most profitable combination of crop and livestock enterprises, and to determine yield increases of forage needed to pay for an irrigation system. Simplified parts of the original model and solution tableau are used in this paper for illustrative purposes.

In considering the different levels of production of dairy cows in formulating a farm plan, the authors followed the procedure of developing a vector for a dairy cow or cows producing a given amount of milk. One such simplified vector for a dairy cow is illustrated in Column 9 of

* Authorized for publication on January 5, 1959, as paper number 2334 in the Journal Series of the Pennsylvania Agricultural Experiment Station.

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[1] For example, see J. N. Boles, "Short-Cuts in Programming Computations," *Journal of Farm Economics*, Vol. 38, p. 981 (1956); Wilfred Candler, "A Modified Simplex Solution for Linear Programming with Variable Prices," *Journal of Farm Economics*, Vol. 39, p. 940 (1957); R. F. Hutton and R. H. McAlexander, "A Simplified Feed Mix Model," *Journal of Farm Economics*, Vol. 39, p. 741 (1957); Horace L. Puterbaugh, Earl W. Kehrberg, and John O. Dunbar, "Analyzing the Solution Tableau of a Simplex Linear Programming Problem in Farm Organization," *Journal of Farm Economics*, Vol. 39, p. 478 (1957); F. V. Waugh and C. L. Burrows, "A Short-Cut to Linear Programming," *Econometrica*, Vol. 23 (1955); and Earl O. Heady and Wilfred C. Candler, *Linear Programming Methods*, Ames, Iowa: Iowa State University Press, 1958.

Table 1. Here, the labor requirement, total digestible nutrients (TDN) requirements, pasture limit, and maximum grain allowance are shown. However, in order to extend the same solution to include other cows of different levels of production without completely re-solving the problem, a "milk increase" vector was developed. The "milk increase" vector, Column 8, was developed for cows of the same weight with production of 1,000 pounds beyond that of the existing cow as shown in Column 9. This vector was formulated by determining and entering the appropriate resource allowances or restrictions for producing 1,000 pounds of milk in the original tableau.[2] According to Morrison,[3] each 1,000 pounds of milk required 320 pounds of TDN beyond maintenance requirements. (The maintenance requirements are taken care of in the "dairy vector.") Thus,

TABLE 1. SELECTED VECTORS FROM A LINEAR PROGRAMMING MODEL

1	2	3	4	5	6	7	8	9
C_j		−$29.15	−$.06	−$32.06	−$.11	−$25.02	$44.74	$415.81
Restrictions	P_0	Hay	1 Per cent Hay increase	Silage increase	1 Per cent Silage increase	Irrigation (one acre)	1,000 lbs. Milk increase	Dairy cow
Land (Ac.)	80	1.0	0	1.0	0	0	0	0
Summer Labor (Hr.)	980	11.1	.03	14.1	.04	3.7	0	11.3
TDN (Lbs.)	0	−2971	−30	−3797	−38	0	320	8142
TDN Limit from Pasture (Lbs.)	0	0	0	0	0	0	0	−3211
Maximum Grain Purchase (Lbs.)	0	0	0	0	0	0	−333	−3000
Grain Maximum (Ac.)	40	0	0	0	0	0	0	0
$Z_j - C_j$	0	$29.15	$.06	$32.06	$.11	$25.02	-$44.74	−$415.81

320 is entered in the TDN row. In the grain purchase row, the quantity −333 appears. This can be explained as follows: An upper limit of one pound of grain for every three pounds of milk produced (a 1:3 grain to milk ratio) was placed in the model. Therefore, a total of 333 pounds of grain are permitted to be purchased for the dairy cow in the programming process. During the regular solution of the problem, the "milk increase" vector is blocked by assigning it some large negative C_j value.

The transformed "milk increase" vector from a solution tableau for 1,000 pounds of milk is shown in Table 2, Column 8. The Z_j-C_j coefficient of this column indicates that returns could be increased by $38.61 from cows producing an additional 1,000 pounds of milk. On the other hand, this also indicates that cows producing 1,000 pounds less milk would reduce returns by $38.61 per cow. These increases and decreases are, of course, applicable to a limited range depending on the available re-

[2] An alternative method of handling this vector and the yield increase vectors to be discussed later would be to develop them by use of disposal vectors of the final solution tableau rather than carry them through the entire solution routine.

[3] Frank B. Morrison, *Feeds and Feeding*, 22nd Edition, Ithaca, New York: Morrison Publishing Company, 1956.

TABLE 2. SELECTED VECTORS FROM A LINEAR PROGRAMMING SOLUTION TABLEAU

1	2	3	4	5	6	7	8	9
C_j		−$29.15	−$.06 1 Per cent Hay increase	−$32.06	−$.11 1 Per cent Silage increase	−$25.02 Irrigation (one acre)	$44.74 1,000 lbs. Milk increase	$415.81 Dairy cow
Vectors in Solution	P_0	Hay		Silage				
Silage (Ac.)	8.4	1.0	0	1.0	0	0	0	0
Purchased Grain (Bu.)	284.4	−18.7	.67	0	.86	0	−4.4	0
Summer Labor Disposal (Hr.)	365.0	−3.0	.03	0	.04	3.7	0	0
Dairy Cows (Hd.)	47.0	0	0	0	0	0	0	1.0
Pasture (Ac.)	31.6	0	0	0	0	0	0	0
C_s-C_o-B (Ac.)	40.0	0	0	0	0	0	0	0
Z_j-C_j*	$17,767.48	$23.09	−$.87	0	−$1.09	$25.02	−$38.61	0

*Some processes were originally blocked from entry. These are the Z_j-C_j with all blocks removed; hence the negative values.

sources and/or restrictions in the model. To determine the effect on the solution for cows with 1,000 pounds greater production, the "milk increase" vector can be brought into the solution at a level of 47 units (47 cows) by simply multiplying the vector by 47 and subtracting these quantities from those in the present P_0 Column. In the particular example shown in Table 2, the new P_0 Column for cows with production of 1,000 pounds per cow beyond that in the original solution would be as follows:

	Old P_0 Column	− (47 ×	"Milk Increase" Vector)	=	New P_0 Column
Silage (Ac.)	8.4	− (47 ×	0)	=	8.4
Purchased Grain (Bu.)	284.4	− (47 ×	−4.4)	=	491.2
Summer Labor Disposal (Hr.)	365.0	− (47 ×	0)	=	365.0
Dairy Cows (No.)	47.0	− (47 ×	0)	=	47.0
Pasture (Ac.)	31.6	− (47 ×	0)	=	31.6
C_s-C_o-B (Ac.)	40.0	− (47 ×	0)	=	40.0
Z_j-C_j	$17,767.48	− (47 ×	−38.61)	=	$19,582.15

If one were interested in studying the effect of cows of lower production on the farm plan, the "milk increase" vector would merely need to be added to the present P_0 Column. This obviously would reduce returns.

In the situation presented here, none of the quantities in the new P_0 column turned negative by the adjustment. If any quantity in the P_0 had turned negative, this would have indicated that the limits within which the marginal rates of return per 1,000 pounds of milk had applied had been exceeded. If this did occur it would be necessary to examine the solution and make adjustments to bring any negative P_0 quantity (or quantities) back to zero. This procedure is discussed elsewhere.[4]

The second objective of this note is to illustrate the use of additional

[4] For details on adjusting solutions see R. F. Hutton and R. H. McAlexander, *op. cit.*

returns in a linear programming model to determine the forage crop yield increases needed to pay for a particular management practice. The example deals with irrigation of 16 acres of forage. The problem situation is that of the dairy farm mentioned previously.

In setting up the linear programming model, possibilities were considered for harvesting the forages as hay and silage. Vectors were built into the model indicating the resource requirements for a yield increase of 1 per cent for these hay and silage crops. Simplified examples of the original vectors for alfalfa-orchardgrass used as hay and silage are shown in Columns 3 and 5 of Table 1. "One per cent increase" vectors for hay and silage are shown in Columns 4 and 6 of Table 1.

An example of the "1 per cent increase" vectors is that of silage shown in Column 6, Table 1. This vector indicates that an additional 38 pounds of TDN would be produced by a 1 per cent yield increase, requiring an increase of .04 hours of labor per acre, and $.11 per acre harvesting costs. This additional cost is reflected in the C_j at the top of Column 6. This, and other "increase" vectors were "blocked" when the solution was run.

Examination of the "1 per cent silage increase" vector in Table 2, Column 6, illustrates that a 1 per cent increase in silage yields would reduce purchased grain by .86 bushels, labor by .04 hours and add $1.09 ($Z_j$-$C_j$) to the return. The "1 per cent hay increase" vector (Column 4) shows that $.87 would be added to the return by the increase in hay yield.

Another vector that was added to the original tableau was an "irrigation" vector which is illustrated in Column 7 of Table 1. This vector indicates that the cost of irrigation of one acre of forage is $25.02, and that each acre requires 3.7 hours of summer labor. This vector was also "blocked" while the main solution was obtained. Examination of the "irrigation" vector in the solution tableau (Column 7, Table 2) shows no change since labor was not restrictive in this simplified situation.

By dividing the costs of irrigation per acre by the additional return (Z_j-C_j) of a "1 per cent yield increase" vector, the percentage increase in yield necessary to equal the irrigation costs is determined. These percentage requirements can then be readily converted to tons per acre for the particular forage crop. For example, the irrigation costs are $25.02 and the Z_j-C_j of the "1 per cent silage increase" vector is $1.09, as shown in Table 2. The percentage yield increase required to equal the costs of irrigation is 23 per cent ($25.02/$1.09). Likewise, the percentage increase in the yield of hay necessary to equal irrigation costs is 28.8 per cent ($25.02/$.87). Yield increases of 23 per cent for silage and 28.8 per cent for hay would just cover the added costs of irrigation. Increases greater than these would be necessary in order to increase "net" returns, or to be more profitable than the present plan.

This system of computing the percentage increase in yields needed to

pay for irrigation costs appears to be more realistic than the usual method whereby a "market" price for hay is used to determine the necessary increase. For this particular problem, the sale of hay was not considered as an alternative enterprise because it is not a common practice in the area studied. However, this could be added to the model by the addition of a row and a column.

We have illustrated in this note how modification vectors can be used in a linear programming model to (1) adjust the solution tableau when several levels of milk production are considered, and (2) to determine the yield increases necessary to pay for irrigation costs. This same procedure could obviously be extended to many other types of linear programming problems, and for a number of different management practices.

NOTE ON THE USE OF TRANSFER PROCEDURES IN LINEAR PROGRAMMING*

ARTHUR J. COUTU, LEE R. MARTIN AND H. S. SINGH**

AS PROGRAMMING is developed into a more complete normative tool for guiding resource adjustments, computational problems arise. A significant one concerns the finiteness assumption that dictates a choice of relevant resource restrictions and product activities. When seeking directional guides for resource use, the analyst's desire for resource flexibility under numerous levels of resource restrictions and activities is limited by computational restrictions. Existing programs for some equipment restrict the programmer to not more than 27 resource restrictions (rows) and 54 disposal and active processes (columns).[1]

In some recent programming of low income farms in North Carolina, sufficient resource flexibility could not be obtained with convential procedures. In this particular case the programmer wanted to relax the cropland and pasture restrictions but to place limits on the land that would be available to rent in, relax labor restrictions by allowing labor to be hired in and at the same time to allow the operator's labor to be hired

* Journal Paper No. 1019 of the North Carolina Agricultural Experiment Station, published with the approval of the Director of Research, Arkansas Agricultural Experiment Station. The technique was developed from the suggestions of, and with a lot of assistance from, George Morton of the London School of Economics (formerly Visiting Professor in the Departments of Agricultural Economics and Experimental Statistics of North Carolina State College); the technique was applied by H. S. Singh in a thesis submitted to the Faculty of North Carolina State College in partial fulfillment of the requirements for the degree of Doctor of Philosophy.

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[1] If the analyst desires to punch out indices for each iteration, the maximum size of problem is 26 rows and 52 columns.

out, and to relax the uses that could be made of any given class of owned or rented land.

The conventional procedure would require a separate activity (that is, a separate column) for each of the above situations; the procedure has the effect of restricting sharply the number of alternative activities that can be considered. For example, with a problem containing 25 resource restrictions the possible number of active processes is reduced to 29 because a disposal column must be allocated for each of the 25 row restrictions (each row is a resource restriction). If cropland is classified by productivity classes or into bottomland and upland cropland as is commonly done to improve the programming model, further limitations are encountered. With grain corn as an activity and cropland classified as above, renting in land as one alternative and the use of hired labor as another alternative, the number of corn activities to consider these possibilities runs to eight sets of enterprise relations. With only 29 activity columns available the maximum number of columns used for grain corn must be brought below eight because this condition unnecessarily restricts the number of gainful activities that can be considered.

One alternative would be the use of a more flexible programming procedure on a given machine. For example, there is a program for some machines that can handle a matrix of 99 by infinity. The primary disadvantage of this program is the great increase in machine time. Another alternative would be to purchase time on a larger machine.

The alternative discussed below involves the use of transfer functions to increase the flexibility of a program limited to a given size of matrix (say 27 by 54). In the illustration accompanying this note, the conventional system would have provided for the appraisal of 30 active processes but the use of transfer functions permits analysis of 40 active processes. Stated another way, only 6 processes could have been handled that would consider the use of rented land, distinguishing family labor from operator labor, the use of hired labor, hiring out of operator labor and the renting out of all classes of land for each enterprise requiring bottomland. With the transfer functions 15 active processes with the described flexibility were considered.

The initial tableau for this programming problem using transfer activities is reproduced in Table 1. The same problem has 24 row restrictions[2] and the maximum number of columns, 54 active and disposal processes. The functions of each type of transfer activity are described below:

1. Columns P_2, P_6 and P_{11} allow land to be rented out; P_3, P_8 and P_{12}

[2] In programs for other farms, other restrictions such as tobacco allotment and poultry house were used. The pasture restriction forbids the ues of rented pasture for poultry or swine enterprises.

TABLE 1. MATRIX[a] FOR A LINEAR PROGRAMMING PROBLEM USING TRANSFER FUNCTIONS

Resources	Unit	Amount	BLO to BLR	BLR to BLO	BLO to TCL	Slack for BLR	ULO to ULR	TCL to PLO	O-I to F-I	H-III to F-III
		P_1	P_2	P_3	P_4	P_5[b]	P_6[c]	P_{10}	P_{14}[d]	P_{19}[e]
Land:										
Bottomland owned (BLO)	acre	45.0	−1.0	1.0	−1.0					
Bottomland rented (BLR)	acre	35.0		−1.0		−1.0				
Upland owned (ULO)	acre	9.0					−1.0			
Upland rented (ULR)	acre	19.0								
Total cropland (TCL)	acre	—			1.0			−1.0		
Pasture owned (PLO)	acre	12.0						1.0		
Pasture rented (PLR)	acre	35.0								
Labor:										
Nov–Feb Operator (O-I)	hour	1920							−1.0	
Family (F-I)	hour	325							+1.2	
Mar–Apr Operator (O-II)	hour	976								
Family (F-II)	hour	165								
May–June Operator (O-III)	hour	976								
Family (F-III)	hour	165								1.0
Hired (H-III)	hour	200								−1.0
July–Aug Operator (O-IV)	hour	992								
Family (F-IV)	hour	168								
Hired (H-IV)	hour	200								
Sep–Oct Operator (O-V)	hour	976								
Family (F-V)	hour	165								
Hired (H-V)	hour	200								
Pasture restriction (PR)	acre	12								
Dairy or beef barns (DBB)	head	25								
Capital:										
Investment, maximum (MIC)	dol.	10,000								
Operating (OPC)	dol.	2,000								
Net revenue (C_j)	dol.	—	19.0	−20.0	0.0	0.0	14.0	0.0	0.0	−0.5

Resources	Unit	MIC to OPC	Nonfarm Work I	Grade A Dairy I	Grade A Dairy II	Beef and Sheep I	Beef and Sheep II	Comm. Layers
		P_{33}	P_{35}[f]	P_{49}	P_{50}	P_{51}	P_{52}	P_{54}[g]
Land:								
Bottomland owned (BLO)	acre			11.0	11.0	3.0	3.0	
Bottomland rented (BLR)	acre							
Upland owned (ULO)	acre							
Upland rented (ULR)	acre							
Total cropland (TCL)	acre							1.5
Pasture owned (PLO)	acre			41.0	41.0	64.4	64.4	
Pasture rented (PLR)	acre							
Labor:								
Nov–Feb Operator (O-I)	hour		−1.0	956.0	956.0	218.0	218.0	66.0
Family (F-I)	hour			239.0	239.0	44.0	44.0	134.0
Mar–Apr Operator (O-II)	hour			491.0	491.0	113.0	113.0	42.0
Family (F-II)	hour			119.0	119.0	23.0	23.0	84.0
May–June Operator (O-III)	hour			372.0	372.0	62.0	62.0	40.0
Family (F-III)	hour			94.0	94.0	12.0	12.0	80.0
Hired (H-III)	hour							
July–Aug Operator (O-IV)	hour			366.0	366.0	14.0	14.0	29.0
Family (F-IV)	hour			82.0	82.0	3.0	3.0	59.0
Hired (H-IV)	hour							
Sep–Oct Operator (O-V)	hour			334.0	334.0	50.0	50.0	31.0
Family (F-V)	hour			94.0	94.0	10.0	16.0	63.0
Hired (H-V)								
Pasture restriction (PR)	acre							
Dairy or beef barns (DBB)	head			20.0		10.0		
Capital:								
Investment, maximum (MIC)	dol.	−1.0			12,510.0	3,000.0	6,700.0	1,300.0
Operating (OPC)	dol.	1.0		5,455.0	5,455.0	1,235.0	1,235.0	2,610.0
Net revenue (C_j)	dol.	0.0	0.5	4,008.0	3,383.0	754.0	569.0	1,351.0

[a] To facilitate understanding by the reader, most of the algebraic signs here have been changed from what would be punched on cards to go into the computer.

[b] The other disposal activities are: P_9 ULR, P_{13} PLR, P_{15} F-I, P_{17} F-II, P_{20} F-III, P_{21} H-III, P_{24} F-IV, P_{25} H-IV, P_{28} F-V, P_{29} H-V, P_{30} PR, P_{31} DBB, P_{32} MIC, P_{34} OPC.

[c] Activities P_7, P_8, P_{11} and P_{12} provide for transferring ULO to TCL, ULR to ULO, PLO to PLR and PLR to PLO; the respective C_j values are 0, −15.0, 9.0, and −10.0.

[d] Activities P_{16}, P_{18}, P_{23} and P_{26} transfer operator labor to family labor for the four additional periods at no cost.

[e] Activities P_{22}, and P_{27} transfer hired labor to family labor for the two additional periods with a comparable C_j value.

[f] Other nonfarm labor transfers for each labor period include activities P_{36}, P_{37}, P_{38} and P_{39}.

[g] The ten active processes not shown included grain corn, truck crops, small fruits, swine and hatching egg possibilities.

allow land to be rented in. In the example, the net revenue (C_j) for renting out bottomland (P_2) is \$19 per acre. To inactivate the renting out process the C_j value would be set at zero and for the renting in process the C_j value would be set at a prohibitive level. Bottomland or upland can be used for pasture [by being transferred to TCL (P_4 or P_7) and thence to PLO (P_{10}); these transfers are costless] if it is profitable.

2. Columns P_5, P_9, P_{13}, P_{15}, P_{17}, P_{20}, P_{21}, P_{24}, P_{25}, P_{28}, P_{29}, P_{30}, P_{31}, P_{32} and P_{34} are actual slack vectors that provide for the condition that all resources need not be utilized. There is no slack for cropland because bottomland owned and upland owned may be rented or transferred to total cropland and thence to pasture. Similarly, there are but two slacks for labor in each period, one for family labor and another for hired; operator labor is transferred to family labor through activities P_{14}, P_{16}, P_{18}, P_{21} and P_{25}. This technique provides for definite allocation of family labor and the substitution of operator labor for any family labor. One hour of operator's labor was assumed to be equivalent to 1.2 hours of family labor. The activities for hiring labor in (P_{19}, P_{23} and P_{27}) provide for hiring only that quantity that will be profitable, in addition to the family labor used. This procedure prevents hired labor from being substituted for operator labor; this is deliberate because hired labor is not considered to be a perfect substitute for operator labor. The labor requirements for each enterprise were worked out in terms of the least amount of operator labor required, with the remainder of the requirement assumed to come from family labor.

3. There are two types of land and labor transfer activities. The first concerns the transfer of owned land to total cropland, total cropland to pasture owned and operator to family labor. Net revenue in these cases is zero because there is no cost associated with the transfer of owned assets but there is an establishment cost of transferring owned total cropland to owned pasture. The second type involves the transfer of rented land and hired labor. These transfers do involve a C_j value other than zero when the programmer desires to consider such possibilities. If the programmer wants to eliminate such a possibility and does not want to rewrite the machine instructions, the C_j value is entered at a prohibitive rate. The C_j value will also have a negative sign.

4. Columns P_{35}, P_{36}, P_{37}, P_{38}, and P_{39} allow the operator to hire out his own labor throughout the five time periods. The C_j value will be the appropriate hourly rate. When the operator's labor is handled this way, it is assumed that the operator can work irregular hours. This condition is valid for many types of part-time farm employment opportunities.

5. P_{33} allows unused investment capital to be used as operating capital if it is needed.

The dairy and beef barn restriction and columns "Grade A Dairy II" (P_{50}) and "Beef and Sheep II" (P_{52}) allow the farmer to expand beyond the capacity of his barn only if the enterprises are profitable enough to cover all costs, including annual fixed costs on additional capacity. No fixed costs for the barn are imputed to dairy or beef enterprises at barn capacity or below.

With this flexibility built into the initial tableau, the programmer continues to complete the model in the conventional manner.

Prior to solving the flexible programming model, one final but critical step is necessary. This involves a check to insure that the transfer activities are linearly independent, that is, that no transfer activity is a linear combination of any other activities. This requires a check that the transfer activities are in standard form or that the sub-matrix containing the transfer activities can be reduced to an identity matrix.

A WORD ON A WORD

One word crept into my article in the May issue which changes the emphasis substantially. It was not in the original manuscript, but I overlooked it in the galley proof. Its insertion by the editorial assistant or the typesetter and my slip on the galley proof dramatize our casual ethnocentrism.

On page 216 in the third full paragraph, I originally wrote "one can argue that the international interests of the people of each of our states are such that a small fraction of the state funds can legitimately be used for such activities." The word materializing unexpectedly is "only," appearing after "such that." This substantially changes the implication.

Actually, I would argue that in all states some funds can legitimately be used, and in some states a great deal should be used. States like Illinois and Iowa should know a great deal more about foreign markets for soy beans than they do. The economic interests of their farmers would warrant research projects and trips abroad to become more familiar with current and prospective oil competition. Similarly, states like Texas and Mississippi could defensibly spend state funds to study and report on cotton production in Mexico, Brazil, Egypt and India, or on market outlets in Japan, Italy and Great Britain. Kentucky and tobacco, the Great Plains states and wheat, Michigan and automobiles (in both importing and exporting countries) are additional examples.

This little error shows how hard we have to work at broadening our perspectives.

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"If a backward country, such as Japan was in 1850, is to modernize as rapidly as Japan did, it seems necessary that it satisfy a minimum of four conditions. First, it must have a leadership with a vision of a future radically different from the past. Second, the leadership must have control over a government with a high degree of authority and stability for decades . . . Third, the economy must afford the means of investing on a significant scale. Last, industry must have a satisfactory supply of labor. . . ." (p. 201)

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REVIEWS

Water Resource Development: The Economics of Project Evaluation, Otto Eckstein. Cambridge: Harvard University Press, 1958. Pp. xiii, 300. $6.50.

Dr. Eckstein's treatise adds materially to the rapidly expanding authoritative reference material available to resource economists. While the book under review may be considered as bearing a complementary relation to the author's joint work with John Krutilla, "Multiple Purpose River Development," it covers many of the same evaluation areas as are treated by Ronald N. McKean in "Efficiency in Government Through Systems Analysis." All three books were published within a few months during the first half of 1958.

The introductory chapter cites the growth in expenditures for water resources, traces the stages through which project plans must pass before they can be undertaken, cites proposals that have been made for administrative and organizational reforms in project review and appraisal, and points out the need for evaluation standards that promote the welfare of the country.

The next three chapters are devoted to the development of the general theoretical framework of benefit-cost analysis and the selection of the appropriate criterion. The theory of the competitive economy in allocating resources is sketched and its implications for evaluation of public projects indicated. The competitive model is considered adequate as the primary base for the theoretical framework, subject to possible modifications under such conditions as increasing returns, physical interdependence, immobility of labor, unemployment, collective goods, income distribution impacts and imperfections in the capital market affecting the allocation of resources over time.

In dealing with investment criterion, the author contends that greater stress should be placed on the use of benefit-cost analysis for measuring relative rather than absolute values; that alternative costs are not a substitute for market values of benefits unless they are certain to be undertaken; that the total Federal cost is usually the most appropriate form of budget constraint and the benefit-cost ratio the preferable criterion; and that projects should be formulated so as to maximize benefits within given budget constraints, with the benefit from the marginal dollar of expenditure the same for all projects and purposes.

Dr. Eckstein favors treating risk through a premium allowance in the interest rate; feels that the depreciation rate should be geared to the true rate of capital obsolescence; proposes a compromise in handling interest in which a relatively low interest rate would be used in evaluation

and design, but only projects constructed having sufficiently high benefit-cost ratios to assure an average rate of return as high as in the sources from which resources are diverted. He is inclined to feel that projected prices provide a better measure of relative values than would prices prevailing in a given year.

Chapters V through VIII are devoted to a discussion of prevailing evaluation practices in flood control, irrigation, navigation, and electric power; with suggestions for their improvement. Each chapter in this group has a section dealing with cost-sharing problems of the purpose under consideration. The principles and techniques for the allocation of joint costs in multiple-purpose projects are discussed in chapter IX. The separable costs-remaining benefits method is considered acceptable in that it does not interfere with correct investment and output decisions. The final chapter summarizes the author's major recommendations.

There is likely to be rather widespread agreement among those familiar with benefit-cost analysis in Dr. Eckstein's general conclusions that prevailing procedures and cost-sharing requirements leave much to be desired, although the potential of proper evaluation approaches is promising. Furthermore, there would appear to be considerable merit in at least the general direction of most of his more specific recommendations.

The issues most likely to remain controversial are his treatment of interest and of budget constraints. A commonly accepted conceptual basis for an interest charge in the evaluation of public projects is the expected productivity of capital in alternative opportunities that are precluded. Whether such an opportunity cost is appropriately measured by either private time preference, social time preference, or their combination in the approach proposed by Dr. Eckstein would appear to be open to question.

Even though the desirability of the objective of maximizing net benefits under budget or other constraints is recognized, questions arise concerning both its form and the practical feasibility of its application. Federal funds are frequently not the controlling limitation in projects, particularly those involving participation by individuals and State and local agencies. Treating the Federal budget as the controlling constraint would limit the possibility of comparing projects in terms of their social desirability. It would also appear to be difficult to devise practical and effective ways of continuously reformulating and reselecting projects for construction in accordance with the budget constraints applicable at the time of initiation.

A few very minor inaccuracies appear in the first chapter. The Federal Inter-Agency River Basin Committee was established in 1943, and not 1946 (p. 11). It was the Benefit Cost Subcommittee that was created in

1946. The revised Budget Bureau Circular was prepared and circulated to the agencies in 1954, rather than 1955 (p. 13). The work of the Advisory Committee on Water Resources Policy was purposely established as an independent effort, and it did not use the findings of the Second Hoover Commission as its point of departure (p. 14).

Considered as a whole, the book provides a penetrating and systematic treatment of the economics of water resource project evaluation. It makes a material contribution toward the clarification of several controversial issues that have plagued both the theory and application of the benefit-cost evaluation method. The treatise merits considered study by all students, technicians, administrators, and policymakers concerned with resource economics.

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Decision Making and Management for Farm and Home, Carl C. Malone and Lucile Holaday Malone. Ames: Iowa State College Press, 1958. Pp. viii, 255. $3.95, cloth.

The preface states that "this book is for farm families and those who teach and counsel with them." Emphasis in the Malones' joint effort is upon the family participating in and becoming a part of a living, dynamic entity, the "farm." The headings of nine of twelve chapters of this book include the word "family."

The book is not a revised edition of the previous work, *How to Make Your Farm Pay*. The previous publication, according to a reviewer, should have included "midwest" in the title since "its illustrations and details on farm organization and operation are essentially limited to the Midwest." This is not a deficiency in the joint product of the Malones. Illustrations of a Carolina tobacco farm, a Mississippi delta cotton farm, a New York dairy farm, as well as farms from other states and economic regions are used in the publication.

The objective is to keep the family in the forefront as managers. The plural "managers" is used purposely for the decision-making farm family. The Malones have attempted to make "decision-making the heart of management," and have de-emphasized many of the mechanistic concepts so prominent in text-books of farm management.

The ideas are organized to present "to farm families and their counselors" two aspects of management: (1) decision-making as a process, whereby values are brought into focus and the problem determined, and (2) decision-making as a plan of action, in which limited resources are organized to reach chosen goals. Chapter I-V establish the foundation for the two-fold approach. In the first two chapters, the authors carefully de-

velop an economic and sociological basis of farming as a business and as a complex, impersonal economic system forcing social adaptation for survival. In the chapter entitled "Setting the Guideposts," values are discussed and made the objects of motivation. By this distinction, decision making becomes a product of the creative thoughts of the farm family as managers. The fourth chapter presents methods of analyzing the weaknesses and strong points of management by the family with its advisors. Alternative combinations of resources are considered, and a basis for action is indicated. Principles of diminishing returns, substitution, and opportunity cost are entered into the family process of "studying its management," as general guides in choice of action.

In the remaining chapters the Malones discuss "The Family Improving Its Farm Plan," "Suggestions for the Younger Family," "Home Making," and "Better Living," and "The Family Studies Itself."

This joint effort of the Malones reflects years of experience of working directly with farm families. The book merits careful study by all teachers and students in farm management. Extension farm management specialists and home economists will find a wealth of material for use in teaching management to farm families. Vocational agricultural teachers, soil conservationists, rural ministers, and others will find that this book challenges them to understand and appreciate problems of rural people in a complex economic setting. Professional workers will gain an understanding of why farm families are slow in embracing proposals or recommendations for action. Emphasizing *family* decision-making over mechanistic farm management techniques is the major contribution of this book.

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Economics as a Science, Andreas G. Papandreou. New York: J. B. Lippincott Co., 1958. Pp. x, 146. $3.50.

The objectives of this book are to examine the character of economics as a science, to explore its foundations from a logical point of view (i.e. in terms of symbolic logic), and to spell out its limitations.

The view of economics as a science is admittedly partial. It includes only economic systems amenable to mathematical treatment. Welfare (non-positive) economics is not dealt with. There is no discussion of the theory of choice, though it is alleged that including it would not have changed the conclusions. Only comparative statics is dealt with.

Eight substantive conclusions may be enumerated as being important to Papandreou:

1. Sharp distinctions between "assumptions" and "hypotheses" can be made profitably only on a deductive, formal plane. It is appropriate to bring empirical evidence to bear on a theory at all levels.

2. For the most part economists made models rather than theories. (In Papandreou's terminology a theory specifies completely the conditions under which it can be refuted empirically; a model omits some specifications so that it cannot be refuted.)

3. Shift parameters make theories into models.

4. Typically a basic theory is not very useful, because there are many augmented theories that can be derived from it and all would have to be refuted to refute the basic theory. (A basic comparative statics theory ignores dynamic processes and probabilities associated with deviations from equilibrium. An augmented comparative statics theory specifies a dynamic process and the maximum ignorable deviation from equilibrium.)

5. To use comparative statics, we need an assumption that certain observed values are equilibrium values. This assumption involves probability and a concept of deviation not greater than a specified quantity. Hence we need to deal with dynamics, in terms of the speed of change.

6. Economics consists largely of ex post explanation.

7. In principle we can construct theories, but cannot yet test theories as well-developed sciences test them.

8. Economists usually work with general flexible explanatory schemata having substantial heuristic value. Meaningfulness in the Samuelson sense (operationally meaningful, capable of refutation by empirical evidence) is a program of research rather than an established fact.

Perhaps limitation of time and space is responsible for the author's confining himself to comparative statics. However, as he notes, discussion of comparative statics forces him to introduce dynamics and probability conceptions. The ways in which involvement with dynamics and probability affects his conclusions are only hinted.

In dealing with the logical basis of economics, Papandreou uses rather formidable symbolic logic. This practice is one of the great weaknesses of his book. The use of symbolic logic in this case appears unnecessary and distracting.

The case for using symbolic logic is closely related to the case for the use of mathematics in general. Use of the symbols and rules of mathematics is unquestionably essential to a satisfying rate of development of some parts of economics. Thus, for instance, I doubt that a non-mathematical treatment of dynamic processes could have led to useful general solutions. In such a case, we are not concerned simply with translations among languages; we are concerned also with operations which are simple in a mathematical language but difficult in English. Nothing analogous to this dynamic-process gain appears to have occurred through use of symbolic logic in the volume under review.

In this connection, one of Papandreou's innovations deserves special attention. He believes that in addition to specifying the economic varia-

bles appearing in the theory one ought to specify the observation acts that yield the values of the economic variables. He distinguishes between observation acts which identify the "social space" and observation acts which finally yield the values of the economic variables. In brief, the social space relevant to a given theory is the set of side conditions under which the theory is alleged to be accurate. But it should be clear even without recourse to symbolic logic that an economist enunciating a theory should state the conditions under which the theory is applicable. More simply, the theory can be interpreted as including a statement of all the conditions relevant to testing the theory.

Emphasis on a set of observation acts (as contrasted with the observations yielded by the acts) seems unwise in a setting, such as Papandreou's, in which we are not concerned with statistical issues. Once we have specified the variables to be observed in terms of time and place, there is no need for consideration of sets of observation acts; all sets of observation acts relevant to the variables as defined should yield, on Papandreou's assumptions, the same set of observed values of the economic variables.

In connection with the concept of limitations on the work of economists, Papandreou has dealt with difficulties rather than limitations. He does not specify actions with economists can perform properly and efficiently. Rather he indicates some of the reasons why empirical work in economics is difficult. A significant difference of emphasis is involved. If a person could state the limitations of economics in a convincing way, he might thereby show economists the realm within which their competence is socially useful. (This is not to suggest that the discussion of difficulties is less important than the discussion of limitations.)

Documentation is disappointingly scanty. There are a few sweeping generalizations. (Page 115: "The economist, in general, has been satisfied with the construction of models rather than theories." Page 138: ". . . One is led to conclude that economic theories enjoy a high degree of insulation from the impact of empirical data.") In some sense these statements may be true. It would have been valuable, however, to examine carefully at least one piece of empirical research in economics, in connection with the author's indictments of current practice.

Papandreou states that his conclusions could easily have been expanded to include the proposition that economics is predominately a policy science. Development of Papandreou's thoughts on this subject might have been helpful.

Perhaps the difficulties Papandreou exhibits in connection with hypothesis-testing indicate that economists should place great emphasis on careful economic analysis, and slight emphasis on devising equations whose coefficients are capable of relatively precise estimation.

In general, Papandreou's conclusions seem sound, although after he has

introduced dynamics and probability considerations the conditions under which the conclusions are alleged to be valid are unclear.

J. A. NORDIN

Iowa State University

The Fertilizer Industry: Study of an Imperfect Market, Jesse W. Markham. Nashville: Vanderbilt University Press, 1958. Pp. 249. $6.00.

Professor Jesse W. Markham has produced another fine industry study. His first, *Competition in the Rayon Industry,* published in 1952, was a pioneer study in the relatively new applied field of "industrial organization and public regulation." The present volume on *The Fertilizer Industry* is a sure "must" for any graduate course in agricultural marketing. Indeed, production economists, for as long as anyone has admitted to being such, have lamented our lack of systematic knowledge on major agricultural input industries such as machinery, fertilizer and credit. Markham has made a significant contribution to the filling of this gap.

Following an introduction to the problem in Part I, the organization and structure of integrated fertilizer industries is described in Part II. The organizational center of the fertilizer industry lies in the vertically integrated firms that cut across the phosphate rock, the superphosphate and the mixed fertilizer industries. In Part III Markham briefly discusses the organization, structure and market practices of the sulphur, potash and nitrogen industries. These industries provide complementary inputs for superphosphate producers and fertilizer mixing firms. Returning to the integrated fertilizer industries in Part IV, Markham takes up the pricing, production and distribution practices of firms in the phosphate rock, superphosphate and mixed fertilizer industries. In the last section of the volume, Part V, the imperfections of the fertilizer market are assessed and an attempt is made to quantify the social costs of these imperfections. Monopolistic restraints, combined with imperfect knowledge on the part of farmers constitute the major imperfections. Past fertilizer policy and programs are reviewed critically in a final chapter and some guides for future policy are suggested.

It is not possible here to summarize Markham's data on the degree of concentration and integration in the various industries making up the fertilizer industry. Suffice it to say that the phosphate-rock industry is a clear example of oligopoly; similarly a high degree of concentration characterizes superphosphate production; mixed fertilizer production exhibits a far lower degree of concentration but is still a highly imperfect market. The complementary inputs of nitrogen and potash and the sulphur used in superphosphate production also come from extremely imperfect markets. Not only are all six of these industries imperfectly competitive by virtue of their structure, but some of the major firms in each have at least

once been subject to anti-trust action for monopolistic practices in pricing or restriction of entry. The phosphate rock, nitrogen, potash and sulphur industries have all been part of international cartels in the past.

Not only imperfect competition and oligopoly but integration characterizes the fertilizer industry. Vertically-integrated phosphate fertilizer firms "account for seventy-five to eighty per cent of the output of (phosphate) rock, they account for about fifty-five per cent of the output of superphosphates and less than half the output of mixed fertilizers."

Professor Markham concludes that anti-trust action has reduced the social costs of monopoly in the fertilizer and associated complementary input industries about as far as anti-trust action can feasibly do so. This still left monopoly or oligopoly profits of between 10 and 15 million dollars a year in 1946. Excess profits, of course, do not measure all social costs but Markham estimates that the total social cost of monopoly in fertilizer is between 2.5 to five per cent of the nation's total expenditures on fertilizers.

Outside of anti-trust, certain other lines of action are suggested for the phosphate-rock industry. Divestiture of ownership or control over high grade rock reserves now generally held by the seven large integrated Florida firms is a possibility. More feasible in Markham's view would be action to develop the smaller primarily Western producer. The market for fertilizer in the West and Midwest has grown rapidly in the post World War II period and the Florida producer is beginning to lose his locational advantage. Markham suggests that this trend be accelerated through public research on phosphate technologies, vigorous public prospecting for new rock sources in the West and a preference to new over entrenched firms in leasing the public domain. These activities should increase the strength and numbers of independent firms. Vigorous application of the Clayton Act to prevent future mergers is also recommended.

The only way Markham believes it possible to reduce concentration of control in natural sulphur is through limiting the leaseholding and exploration activities of Freeport and Texas Gulf, the two companies producing ninety per cent of all domestic natural sulphur.

A relatively simple solution to concentration of control in the potash industry is available without recourse to anti-trust action. Since all large producers operate under lease on the public domain and since most present reserves are also in the public domain, the government through its leasing activity has a significant control over entry and distribution. It has only to exercise this control vigorously to reduce concentration.

On the demand side of the market for fertilizers, Markham identifies a far greater imperfection than the monopoly elements of the supply side. This is the irrational demand and imperfect knowledge demonstrated by farmers in buying fertilizer. It has long been observed that farmers could get more nutrients for each dollar spent if they would only purchase high

analysis (25 per cent or more nutrients by weight) rather than low analysis fertilizer. Markham argues convincingly that the predominance of low analysis fertilizer sales is not due to a failure of the industry to offer high analysis mixes but rather to imperfect buyer knowledge and to an irrational demand for low analysis fertilizer.

The social cost of this imperfection on the demand side of the market is measured by computing the saving that farmers would gain if they purchased all their plant nutrients in the form of high analysis fertilizers. Markham's computations indicate that the social cost of imperfect buyer knowledge and irrational demand comes to around 10.5 per cent of the annual farm expenditures on fertilizers. This is significantly greater than the 2.5 to 5 per cent in social cost attributable to the monopoly elements of the supply side of the fertilizer market.

Thus, Markham argues that the greatest potential social gain from policy action lies not in the area of anti-trust action but in what he calls "positive policy." That is positive actions to reduce concentration such as is indicated above and positive action to inform and educate the farmer on rational buying and use of fertilizer. In reviewing present programs in which fertilizer policy is either a direct or ancillary concern, Markham finds that the Agricultural Conservation Program (ACP) and the current regulatory efforts of State Fertilizer Control Boards not only promote irrational fertilizer buying but actually prevent efficient use of fertilizers. The obstacles to improved "positive fertilizer policy" are (1) lack of coordination of fertilizer programs, (2) confused and unclear objectives and (3) ineffective channels of communicating fertilizer knowledge to farmers.

This is one of the most economically written and well organized industry studies this reviewer has yet read. Perhaps because of this some things are not handled in the fullness one might desire or are not discussed at all. It is not possible from the book to reconstruct the actual inter-industry organization of the vertically integrated sector of the fertilizer industry. It is, thus, not possible to be precise about the inter-relationship between the concentrations of control in the various industries making up the fertilizer industry.

One wonders why behavior and performance data are not developed for the superphosphate industry as was done for all other of the industries related in fertilizer production.

A theorist would say too, that the analysis at some points stops well short of fully exploiting the empirical data of the study. To give one example, it is observed that overhead costs in superphosphate production are no more than five to ten per cent of total cost, yet no implication is drawn from this for the nature of price competition in what is clearly an imperfect, if not an oligopoly, market structure.

A depressing occurrence of interest to agricultural economists is brought to memory by a minor error that occurs on page 210. Here Markham refers in the present tense to the Bureau of Agricultural Economics. *Tempora mutantur!*

JAMES T. BONNEN

Michigan State University

The Income of Nations, Paul Studenski. Washington Square: New York University Press, 1958. Pp. xxiii, 554. $25.00.

This book is described by the publisher as ". . . the most comprehensive study of national income ever undertaken." It is intended to be a complete survey and appraisal of the global development of national income in its historical, conceptual and methodological aspects. Although somewhat formidable in scope and size, the book generally achieves its goal in the form of a reference type volume. The study is divided into four parts. It treats systematically the history, the basic concepts, and methodology of national income, and concludes with a survey of actual estimating experiences and a statistical appendix.

Part I establishes the genealogy of the national income concept. Beginning with the seventeenth century estimates of Petty and King in England, its history is traced through the work of individual investigators and concludes with the "universalization" of the concept and the flourishing of government research in the twentieth century. A wealth of detail is provided. Particular attention is given here, and throughout the volume, to the different concepts of production underlying the estimates. Present day illustrations of these differences can be found, for example, in the Russian estimates and those of the United States. The former are based on the restricted material production concept while the latter reflect the comprehensive market production idea.

Having described the lineage of national income, Studenski examines its conceptual and theoretical basis. He follows the usual pattern of such discussions but presents the varying points of view for the more controversial elements. He stresses the importance of considering economic production as a double flow of product and income capable of measurement at anyone of three stages: production, distribution, and expenditure. This three-fold approach provides the framework for his analyses and his discussion of estimating methods. Recent developments and recommendations, relating particularly to the expansion of the national income series into a complex system of economic accounts, are noted. A chapter on intertemporal and interspatial comparisons is included.

Part III reviews in a very intensive manner the estimates of thirteen countries. The countries chosen provide a cross-section of geographic

areas, varying conditions of statistical and industrial development, and concepts of production. The list includes Russia but excludes the United States and the United Kingdom. Extensive references to the latter two countries appear elsewhere in the volume, however.

Supplementing this rather detailed consideration of sources and methods, is a review, in Part IV, of the progress made in sixty-six additional countries. Persons interested in what has been done—in methods of measurement rather than concept—will find these descriptions of actual country practice useful.

The encyclopedic character of this work makes it somewhat difficult to appraise. But this same characteristic is perhaps its most noteworthy feature. The volume brings together in one place a vast amount of information on the various aspects of national income. From this standpoint, Parts I, III and IV are of interest: Part I for its rather unique survey of the historical development of the concept; Parts III and IV for their coverage of the actual estimating experience of so many countries.

With regard to the latter, this area of national income work has been somewhat neglected. Although less attractive than the conceptual and theoretical aspects of the work, the need for descriptions of methodology is great. Such descriptions are basic to judgments of reliability and usefulness. They are also important in explaining differences in country estimates arising from the use of different sources and methods. Studenski has compiled such data for his review from widely scattered sources. One is impressed by the amount of detail and documentation. Students, researchers, technicians, here and abroad, will find this an important reference, both as a direct source of information and as a guide to additional data and further study.

NORA E. DOLLYMORE

Washington 25, D.C.

Concepts and Cases in Economic Analysis, Aaron W. Warner and Victor R. Fuchs. New York: Harcourt, Brace and Company, 1958. Pp. xvi, 288. $2.75.

In the summer of 1958, there was a conference at the Merrill Center on the elementary course in economics. Of the numerous papers prepared for the conference, the one by Victor R. Fuchs was among the two or three most interesting. He and Warner had developed a set of cases (published in the paper-bound book under review) for introducing economic theory to prospective majors in their second semester of work in economics. The course is taught at Columbia to students older than the usual college sophomores.

Warner and Fuchs follow the sound principle of introducing one idea in a short session (e.g., the economic meaning of "demand" on pp. 28-30)

and following it by several "cases." Case 2-1 on p. 30 consists of five short quotations (for instance, "We, the members of the Greenback party, demand cheap money"), followed by questions ("In which of these statements is 'demand' being used in an economic sense?"). Case 2-3 (pp. 31-33) consists of an excellent long quotation on the need and demand for physicians from the *American Economic Review* with appropriate questions. The next section introduces the concept of a demand schedule (pp. 41-46), followed by more cases. In the Warner-Fuchs course, the students prepare the answers to a large percentage of the cases out of class.

In my opinion, Warner and Fuchs are on the right track. The best way for a student to learn an idea is to apply it to a new situation. The best way for him to learn a sequence of ideas is to master each concept before going on to the next. The case method used in law and business schools and the problem-solving method used in mathematics employ these principles. Many of the cases of Warner and Fuchs are well-chosen and are helpful teaching aids. Their approach represents an advance over the familiar workbooks designed to accompany textbooks. Problems and text belong in the same volume.

Unfortunately, the Warner-Fuchs book is not likely to have the impact on teaching methods nor the widespread use that the inherent value of their approach warrants. Their space is badly allocated among subjects. Part of the book overworks the principle of getting the student to master one small piece of analysis before he goes on, part of the book underworks it. Seventy pages (one-quarter of the book) are devoted to supply and demand considered separately before they are brought together in a chapter of 30 pages. The next 55 pages get devoted to elasticity. In contrast, there are only 42 pages on marginal analysis (marginal revenue, marginal cost, marginal product, and marginal utility—any one of them would have been short-changed on the basis that space was allocated to supply and demand even if it had had the whole 42 pages). Macroeconomics gets only 59 pages (16 for the quantity equation, 43 for Keynesian economics). Creation of money by banks and instruments of Federal Reserve control, a fertile field for analytical problems, has the surface barely scratched. Despite many valuable cases, there are numerous others that would be better skipped.

RENDIGS FELS

Vanderbilt University

Economic Planning in Underdeveloped Areas, Edward S. Mason, New York: Fordham University Press, 1958. Pp. x, 87. $2.50.

In his new book, Professor Mason has given us an excellent introduction to the study of economic growth in underdeveloped areas. While Mason is mainly concerned with the role of government economic plan-

ning, most of the complex economic problems facing such areas are presented concisely but not superficially.

Mason attempts, in his words, ". . . to describe and explain rather than to judge . . ." the relationship of business and government in the underdeveloped countries of the world. Fortunately, he is not content to describe only but, while eschewing judgment, subjects fact and opinion to critical evaluation.

Like so many students of economic growth, Professor Mason uses the history, especially the nineteenth century history, of the industrial nations as a frame of reference. Accordingly, he describes briefly the role of government during the early stages of economic development in Britain, Japan and the United States. Yet, the relevance of this experience is, in Mason's mind, uncertain. "In certain parts of the underdeveloped world it needs to be stressed that the pre-conditions of growth have not yet been met. In these areas the availability of financial resources either from domestic or foreign sources may permit the construction of impressive facilities and the transplantation of Western techniques; but without the deeper political and social changes, the initiation of a sustained growth process is dubious." (p. 38) With the possible exception of Latin America, one cannot find ". . . a population as prepared for economic development and industrialization as were the early nineteenth-century populations of the West." (p. 39)

The remainder of the book is devoted to presenting the case for extensive government direction of the economy and reviewing the results of economic planning in South and Southeast Asia. Throughout this discussion Mason considers separately the problems of resource expansion, resource allocation and resource management. In each category, he concludes, "It is obvious that the case [for planning] rests more strongly on the admitted deficiencies in the private sector in underdeveloped countries than on any demonstrated capacity of government to make good these deficiencies. . . . As in some other fields of activity and of discourse, the best defence is the attack. In many underdeveloped countries the planners are clearly on the attack." (pp. 54, 58)

How successful the planners will be is another matter. "The tasks imposed by these development requirements . . . are quite beyond the capacities of government in a number of underdeveloped countries. This is conspicuously so in some of the countries in Southeast Asia and the Middle East. . . . In other countries, the task may not lie outside the capacity of government, though the problems are formidable. At the present time India appears to offer the best possibilities for a government with this capacity." (p. 58)

Mason's comments on the possibility of economic growth regardless of the degree of planning are also instructive. "Latin America is the only

part of the underdeveloped world of which it can be said that certain countries are well along toward the achievement of sustained growth. The student of economic development interested in observing the growth process in motion is well advised to repair to Latin America. In Southeast Asia and the Middle East this process is not, as yet, well begun. Africa belongs to the future." (p. 59)

On the whole, Professor Mason's book is a sympathetic yet balanced, appraisal of planning for economic growth. However, in view of his concern with the problems of Asian countries and his repeated assertion that these countries have yet to achieve the pre-conditions of development, one may wonder why he chose to compare their public policy decisions with similar decisions made by Western governments in the nineteenth century. A more informative comparison might result if, when considering government-business relationships, an earlier period were used. Actually, no particular historical era may be relevant in this area, for, as Mason points out, "Democratic planning is something very few in the world . . ." (p. 80)

PAUL T. BECHTOL

Colorado College

Perspectives on Conservation: Essays on America's Natural Resources, Henry Jarrett (Ed.). Baltimore: The Johns Hopkins Press, 1958. Pp. xii, 260. $5.00.

This book includes twenty-three papers presented in six programs of a Resources for the Future Forum in Washington, D.C. during early 1958. The aim of the book as stated is "to bring expert opinion to bear upon a few resource problems of wide interest and significance." The book is organized in six sections as follows; I. The First Fifty Years, II. Science, Technology, and Natural Resources, III. Resource Demands and Living Standards, IV. Urban Growth and Natural Resources, V. Some Determinants of Resource Policy, and VI. Organizing For Conservation and Development.

The major resource problems of the United States are considered from varying points of view. Differences of opinion are readily apparent on such points as technological potentials vs. the Malthusian concept, the public vs. the private interest, wasteful consumption vs. future needs, and the place of government in resource conservation. These and other specific considerations are discussed with competence by the several authors. In some instances, individual writers show the bias of the interests they represent but there is an excellent balance among points of view.

The book is well organized and the reader with some understanding of resource conservation will reach the conclusion that a comprehensive consideration of the over-all problem has been achieved. The book is, however, a collection of independently written essays on resource conservation

and there is no welding together of the differing viewpoints into specific conclusions or recommendations. For that reason, the book would not be particularly suitable for undergraduate students but it should serve a useful purpose in graduate courses and among individuals studious enough to develop their own philosophy of resource conservation.

ROY E. HUFFMAN

Montana State College

The Analysis of Multiple Time-Series, M. H. Quenouille. New York: Hafner Publishing Company, 1957. Pp. 105. $4.75.

This work is the first monograph in a series edited by Maurice G. Kendall and described by the publisher as ". . . intended to fill a need which has been evident for some time and is likely to grow: the need for some form of publication at moderate cost which will make accessible to a group of readers specialized studies in statistics or special courses on particular statistical topics." It is to be hoped that future publications in this series measure up to the quality of the one under review.

In this monograph Quenouille sets for himself the task of filling some of the numerous gaps in our knowledge relating to the theoretical and practical analysis of multiple time series, that is of time series similar to the ones which are related interdependently or recursively in usual econometric models. The range of his considerations is revealed by the following questions listed in the introduction to his work.

(1) In what ways may the generation of several interdependent time series be specified and what are the correlation properties of the various specified schemes? (Chapter 2)

(2) If the correlation properties of several series are known exactly, how far is it possible to determine their method of generation? (Chapter 3)

(3) How is the answer to (2) changed if the correlations are subject to sampling variations? (Chapter 4)

(4) What are the most likely manners in which a scheme may be incorrectly specified and how will this affect the analysis? (Chapter 5)

(5) How may the parameters of any scheme be estimated (Chapter 6) and hypotheses concerning any fitted schemes tested? (Chapter 7)

(6) How well do these methods work when applied to actual practical series? (Chapter 8)

That this wide range of topics is treated well within the space of 105 pages is a tribute to Quenouille's formal neatness, compact notation involving extensive use of matrix difference operators, and succinct verbal exposition.

In essence Quenouille's work represents a skillful and imaginative generalization of methods available for the analysis of a single time series to

the analysis of multiple time series. In place of the autocovariance function (and/or correlogram) employed with single time series, Quenouille utilizes covariance (and/or correlation) matrices in his analysis. The population value of such a covariance matrix, with lag s, is $\Gamma_s = Ex_t x_{t-s}'$, where E is the expectation operator, x_t a column vector with p components, x_{1t}, x_{2t}, . . ., x_{pt}, and x_{t-s}' the transposed vector with components lagged s time periods. For stationary time series, the elements of the pxp covariance matrix will be constant parameters and the set of such matrices, Γ_s, $s = 0, \pm 1, \pm 2, \ldots$, contains valuable information regarding the nature of the stochastic process generating observed values of the random variables, x_{1t}, x_{2t}, . . . x_{pt}. Given the stochastic process generating the p variables, Quenouille is able to derive associated relationships connecting the covariance (and correlation) matrices Γ_s, $s = 0 \pm 1, \pm 2, \ldots$, a procedure which is quite similar to the analysis of a single series where knowledge of the underlying process generally enables one to deduce properties of the autocovariance function (or correlogram). In the course of this work, Quenouille develops a covariance generating function which greatly simplifies the determination of the covariance matrices given the underlying multi-equation stochastic process. Also, he shows how to construct canonical variables which are extremely useful in analyses of multiple time series.

Of course, in actual practice, one has to use data to estimate the covariance matrices and then, from such estimates, make inferences about the properties of the underlying stochastic process. To provide some measure of the degree of success to be expected with this approach Quenouille applies it to five sets of stationary time series, generated from five known multi-equation stationary stochastic processes, one set of time series generated from a known two-equation nonstationary process and to a set of five agricultural economic time series, 1867-1948, generated by an unknown process. In the reviewer's opinion, the results of the analyses, particularly the use of Quenouille's generalized partial correlation test to determine the order of a multi-equation autoregressive process and his treatment of trend, are such as to warrant serious study of his techniques by all econometricians dealing with time series. That this suggestion is not misinterpreted to mean that all problems associated with the analysis of time series are solved, the reader is referred to Chapter 5 of this monograph which deals with many practical complications of which unknown trends, measurement or other superposed error, shortness of available time series and inclusion of irrelevant or exclusion of relevant variables appear to be the most serious.

That there are many minor misprints and at least one error in the examples may bother some readers; however, these are not of such importance as to confuse the presentation. And since anyone who reads the

book will easily discover these slips, it is not thought worthwhile to list them. Aside from these minor defects, the reader will undoubtedly wish that Quenouille had provided a closer integration of his analysis with the great wealth of literature which has appeared on time series analysis in the last two decades. However, since Quenouille *just* ". . . intended to provide an outline of one approach to the problems of analyzing multiple time series . . ." in a *short* monograph, such an integration might well have defeated his original purpose.

In summary, econometricians should be grateful to Quenouille for spelling out his approach to the analysis of multiple time series, for applying it in an analysis of a problem of a type encountered in econometric research, and for presenting and ably analyzing the practical complications which arise in pursuing this approach. It is to be hoped that additional applications of his techniques are soon forthcoming so that a more accurate appraisal of their ultimate value to econometrics can be made.

ARNOLD ZELLNER

University of Washington

Principles and Practices of Agricultural Insurance, Parimal Kumar Ray. 1 Sanker Ghosh Lande, Calcutta, India: Bookland Private Limited, 1958. Pp. xxvi, 365. Rs. 18 net.[1]

"Principles and Practices of Agricultural Insurance" is based upon information and data collected by the author during the years 1948-1951, while a graduate student at the University of Oxford, England, and used by him in the preparation of Ph.D. thesis. In this connection, the author explains that this book is a "revised and enlarged version" of his Ph.D. thesis. In collecting data for his thesis–and eventually this book–the author visited and interviewed officials of insurance institutions in Great Britain, West Germany, Sweden, Denmark and the United States. From France, Japan, India and other countries, he obtained data by correspondence.

Dr. Parimal Kumar Ray, the author, is an economist with the Food and Agriculture Organization of the United Nations, Rome, Italy. He was a gold medalist of Calcutta University and a former professor of agricultural economics at Bangabasi College, Calcutta, India.

Dr. Ray begins his book with a rather comprehensive analysis of risks that farmers must contend with in producing a nation's supply of food and fiber. From an imposing array of hazards, ranging all the way from

[1] A copy of the book may be obtained in this country from any of the following agents of the publisher: Sidney Kramer, 1722 H Street, N.W., Washington 6, D.C.; Kelley and Millman, 400 West 23rd Street, New York 11, New York; Barnes and Noble, 105 Fifth Avenue, New York 3, New York; and Stechert-Hafner, 31 East 10th Street, New York 3, New York. ($4.00)

the failure of seed to germinate in the spring to a possible price decline at harvest time, and including in between the possibility of loss from hail, flood, fire, lightning, and windstorm, he selects, for further treatment, those risks that he considers to be insurable.

Methods that have been used in various countries in providing insurance coverage against each of these hazards are then discussed from the standpoint of the nature of cover, insurable amounts, premium rates, assessment and payment of premiums, terms and conditions of contract, and procedure in the case of loss. Examples and illustrations are used to show differences between countries.

In the chapter on hail insurance, frequent reference is made to hail insurance practices in the United States, Canada and Great Britain. Occasional reference is made to hail insurance practices in France, West Germany, Switzerland, and other European countries.

Under the heading of "All Risks Crop Insurance" the author refers briefly to attempts that have been made to write this type of insurance in Finland, France, Germany, Greece, Bulgaria, Denmark, Japan and the U.S.S.R. However, the only program that is described in any detail is that of the Federal Crop Insurance Corporation in the United States. Here he has a rather complete description of the U. S. crop insurance program as it has operated from its beginning in 1939 and up to and including 1956.

A chapter on livestock insurance is based to a large extent upon practices prevailing in the United Kingdom, with brief references to livestock insurance in about 12 other countries. Little or no reference is made to livestock insurance in the United States.

The only reference to the insurance of farm buildings is incorporated in the chapter headed "Insurance of Farming Stock Against Fire." Readers who expect to find this subject treated with a prominence equal to or exceeding hail insurance, livestock insurance or farm liability insurance, may be disappointed. This chapter does contain a fairly adequate description of the organization in operation of Farmers Mutual Fire Insurance Companies in the United States and Great Britain, but the reader may have to search to find it.

The person interested in insurance principles and practices in his own country only will find that he has to sort through a good bit of material to get what he wants from the publication. On the other hand, for anyone interested in a quick review of agricultural insurance as it is practiced in various countries around the world, this book provides a ready source of well organized information.

FRENCH M. HYRE

Farmer Cooperative Service, USDA
Washington 25, D.C.

NEWS NOTES

KEISTER N. ADAMS, a Ph.D. candidate at the University of Maryland has accepted a position with the Standardization and Program Development Branch, Dairy Division of A.M.S. in Washington, D.C.

FRED B. ANDERSON was promoted to Associate Professor of Agricultural Economics at the University of Arkansas effective July 1, 1959.

JAY C. ANDERSON has been appointed USDA collaborator with the Farm Economics Research Division, USDA and is stationed in the Department of Economics and Sociology at Iowa State University.

ROICE H. ANDERSON, Professor of Utah State University, will spend the 1959-60 academic year at the Food Research Institute, Stanford University, under a post-doctoral fellowship granted by the Relm Foundation.

W. J. ANDERSON, Department of Agricultural Economics, The University of British Columbia will spend June, July and August in Singapore and Malaya as a Colombo Plan member of a commission to investigate the Malayan pineapple industry.

WADE H. ANDREWS, associate professor of rural sociology at the Ohio State University will return to the campus after a six-month's leave on the staff of a research project in the University of Idaho dealing with problems related to highway construction in rural areas.

PAUL A. ANDRILENAS joined the Washington staff of the Farm Economics Research Division, ARS, in May. He will conduct studies in contract farming and integration with respect to hog production.

ROBERT ANGUS, who recently completed requirements for a Ph.D. at Penn State University has joined the staff at the University of Arizona as Assistant Professor of Agricultural Economics.

GEORGE BAKER who has been on leave from the Purdue staff at the Harvard Graduate School of Business Administration rejoined the Purdue group July 1.

RALEIGH BARLOWE has been appointed head of the Department of Resource Development at Michigan State University. In his new assignment beginning September 1959, he will direct a teaching, research, and extension program concerned with the optimum use, development, and conservation of land and water resources.

CALVIN L. BEALE, Farm Population and Rural Life Branch, Agricultural Economics Division, AMS, received on May 26, 1959 a Superior Service Award for exceptional contributions as a research worker in demographid fields specifically related to agriculture.

DWIGHT M. BLOOD has resigned as Assistant Professor of Economics at Colorado State University to accept a position as Executive Secretary of the Wyoming Legislative Research Committee, in Cheyenne, Wyoming.

LAWRENCE BOGER visited Colombia in May and June to discuss ways to implement the grant of $194,690 from the Kellogg Foundation to continue cooperative effort with the agricultural colleges in Medellin and Palmira. Substantial emphasis is to be given to the rural social sciences.

ROBERT BOHALL recently joined the Washington staff of the Market Organization and Costs Branch, Marketing Research Division, AMS.

JAMES N. BOLES will be on leave from the University of California for the first six months of 1960 to teach at the University of Padova, Padova, Italy, on a Fulbright Teaching Fellowship.

JAMES BONNEN was promoted to Associate Professor at Michigan State University.

J. CARROLL BOTTUM, Assistant Head of the Department of Agricultural Economics at Purdue, will be on leave from the Purdue staff during the fall semester as a visiting professor at Iowa State College on the staff of the Agricultural Adjustment Center.

HOWARD E. BRACEY, Professor at the University of Bristol, England, has been appointed visiting fellow in rural sociology at the University.

C. ARTHUR BRATTON will be on leave from Cornell University to accept a Fulbright award for lecturing and research at the Institute of Farm Accounting, Kyoto University, Kyoto, Japan, for the academic year 1959-60.

RICHARD L. BURKHOLDER transferred in March from the Lincoln, Nebraska staff of the Farm Economics Research Division, ARS, to the Bureau of Land Management, Department of Interior.

RUEBEN C. BUSE, who recently completed requirements for a Ph.D. at Penn State University, has joined the staff at the University of Wisconsin as Assistant Professor of Agricultural Economics.

HARVEY W. CALDWELL, for the past seven years with the Department of Agricultural Economics, Ontario Agricultural College, Guelph has been transferred to the newly created Department of Extension Education.

D. RALPH CAMPBELL, Head of the Department of Agricultural Economics, Ontario Agricultural College, Guelph, has been appointed to a Committee of Enquiry into marketing in Ontario.

JOE R. CAMPBELL has been promoted to Professor of Agricultural Economics at Louisiana State University.

MARGARET F. CANNON, Agricultural Economics Division, AMS, received a Superior Service Award for developing and improving methods for estimating gross farm income and its various components, and for highly effective preparation and interpretation of this information to interested parties.

FRED CHAPMAN recently joined the Washington staff of the Market Organization and Costs Branch, Marketing Research Division, AMS. He received the M.S. degree from Clemson Agricultural College in June 1958 and has been employed in the Federal-State Crop Reporting Service in South Carolina.

HOWARD E. CONKLIN has been promoted to the rank of Professor at Cornell University

GEORGE J. CONNEMAN, JR. was appointed Assistant Professor of Agricultural Economics at Cornell University on April 1, 1959.

JOHANNES DELPHENDAHL has been appointed as an Assistant Professor in Agricultural Economics at New Mexico State University effective July 15, 1959. He has completed his work for the Ph.D. degree at Michigan State University. He has his B.S. degree in Agricultural Economics from the University of Massachusetts.

PETER DORNER on July 1, 1959, accepted a position as Associate Professor at the University of Wisconsin after spending the past year doing research for the Fund for the Republic. He received his Ph.D. in Economics from Harvard in June, 1959.

WENDELL G. EARLE has been promoted to the rank of Professor at Cornell University.

LUDWIG EISGRUBER has joined the research and teaching staff in Agricultural Economics at Purdue University to work in the area of farm management and production economics.

LONNIE FIELDER, who received the Ph.D. at Iowa State College in May, has been appointed Assistant Professor in Prices and Statistics at Louisiana State University.

OAKLEY M. FROST, Agricultural Estimates Division, AMS, received a Superior Service Award on May 26, 1959 for initiative, imagination, excellent judgment, and exceptional performance in the development of statistical reports for horticultural specialties and the expansion of statistical services on potatoes.

JASPER C. GARRETT, Statistician in Charge of the Montgomery, Alabama Office, Agricultural Estimates Division, AMS, will retire at the end of June 1959 with 35 years and 11 months of service.

HOWARD GILES has joined the staff of the University of Florida in livestock marketing work following completion of his Ph.D. degree at Purdue University this past spring.

HERMAN HAAG will join the Agricultural Industries Department, Southern Illinois University, staff August 16 as visiting professor for the 1959-1960 academic year.

HARLOW W. HALVORSON has been promoted to Professor of Agricultural Economics at the University of Wisconsin.

H. W. HANNAH has returned to the University of Illinois Department of Agricultural Economics as Professor of Agricultural Law after serving as Associate Dean of the College of Agriculture since September 1954.

ALVIN C. HARPER, Assistant Professor in Marketing at Louisiana State University, has received a Southern Education Board Fellowship and will attend Purdue University in 1959-60 to complete work for the Ph.D.

CARROLL V. HESS has resigned his position as Agricultural Economist Farm Economics Research Division, ARS, USDA, carrying on cooperative research with the Department of Agricultural Economics at Cornell, to accept a position as Associate Professor of Agricultural Economics at the University of Minnesota.

WILLMOT G. HILL, formerly employed by the Agricultural Price Statistics Branch, Agricultural Estimates Division, AMS, transferred in February 1959 to the International Cooperation Administration in the Department of State.

JIMMYE S. HILLMAN has been promoted to Professor of Agricultural Economics at the University of Arizona.

DALE M. HOOVER will join the staff of the Department of Agricultural Economics at N. C. State College as Assistant Professor in September, 1959.

LEO M. HOOVER has been promoted to Professor at Kansas State College.

JAMES F. HUDSON has been promoted to Associate Professor in Cotton Marketing at Louisiana State University. He reecived the Ph.D. at Iowa State College in May, 1959.

RUFUS B. HUGHES, JR., will join the staff as Associate Economist at Colorado State University in August. He is currently a visiting professor with the Ford Foundation Unit, University of Madras, Madras, India.

WELLS A. HUTCHINS, Farm Economics Research Division, ARS, received a length of service award at the recent Honor Awards Ceremony of the USDA for his "more than 50 years of service in agriculture."

HILLIARD JACKSON was promoted to Associate Professor of Agricultural Economics at the University of Arkansas effective July 1, 1959. He received his Ph.D. degree from North Carolina State College in May, 1959.

F. G. JARRETT of Adelaide University, Australia, has been appointed a half-time visiting lecturer at Michigan State University effective in the fall.

O. B. JESNESS, Professor Emeritus and former Head of the Department of Agricultural Economics, University of Minnesota, was recently awarded an Outstanding Achievement Award from that institution.

AARON C. JOHNSON, JR., Assistant Agricultural Economist of the Maine Agricultural Experiment Station, resigned in February to accept the position of Price Analyst for John Baxter & Company of Brunswick, Maine.

JACK D. JOHNSON, formerly at Virginia Polytechnic Institute, has been appointed Associate Professor in Livestock Marketing at Louisiana State University. He completed work for the Ph.D. at Iowa State College in August, 1959.

RONALD E. JOHNSON, Agricultural Estimates Division, AMS, received a Superior Service Award for vision, initiative, and devoted adherence to the objective in preparation of a 10-year series of prices received by farmers for milk produced and sold for fluid use and milk produced and sold for manufacturing purposes.

WILLIAM O. JONES, Executive Secretary of the Food Research Institute, will be a Visiting Lecturer in the Agricultural Economics Research Institute, University of Oxford, during the period October 1, 1959 to March 31, 1960.

MONTE JUILLERAT has joined the research and teaching staff at Virginia Polytechnic Institute. He completed his degree in Agricultural Economics at Purdue the spring of 1959.

RICHARD KELLEY has been appointed Instructor in Agricultural Economics, University of Wyoming, effective July 1, 1959.

ROBERT KOCH joined the staff of the research and teaching group at Rutgers University following the completion of his Ph.D. degree in Agricultural Economics at Purdue the spring of 1959.

LEONARD KYLE returned from Colombia to Michigan State in March, to resume his appointment as Extension Specialist.

HARLAN C. LAMPE has joined the Department of Agricultural Economics at the University of Rhode Island.

NORMAN E. LANDGREN has been appointed USDA collaborator with the Farm Economics Research Division, USDA, and is stationed in the Department of Economics and Sociology at Iowa State University.

KARL S. LANDSTROM has been appointed to the Professional Staff of the Committee on Interior and Insular Affairs, House of Representatives as a consultant on public land, mines and mining.

RUSSELL DUANE LLOYD, USDA Collaborator at the University of Nevada in Agricultural Economics was granted a Ph.D. from Utah State in June, 1959.

C. W. LOOMER has been promoted to Professor of Agricultural Economics at the University of Wisconsin.

CARL C. MALONE, Professor in the Department of Economics and Sociology at Iowa State University, has received an award for Superior Service from the USDA "for dynamic leadership in developing a framework and carrying out an interdepartmental approach to the problems of economic and

social growth in Iowa." The award was presented at a ceremony in Washington, D.C. on May 26.

MILTON L. MANUEL has been promoted to Professor at Kansas State College.

RICHARD MAXON, formerly on the staff of the Department of Agricultural Economics at the University of Missouri, joins the Purdue staff in Agricultural Economics August 15, 1959.

GLYNN MCBRIDE was promoted to Associate Professor at Michigan State University.

VERNON MCMINIMY has joined the staff as assistant instructor at Kansas State College. He was a graduate assistant while obtaining his masters degree. He will work on his Ph.D. in addition to research.

HENRY J. MEENEN was promoted to Professor of Agricultural Economics and made Head of the Department of Agricultural Economics and Rural Sociology at the University of Arkansas effective July 1, 1959. He received his Ph.D. degree from the University of Missouri in January, 1959.

JEROME W. MILLIMAN is leaving UCLA to accept an appointment as Associate Professor, School of Business, Indiana University.

DONALD R. MITCHELL has been appointed to Emeritus status at the University of Wisconsin upon his retirement July 1 after serving 37 years on the staff of the Department of Agricultural Economics in Farm Management.

HUGH MOORE has joined the staff of the Department of Agricultural Economics at Purdue to work in the dairy marketing area.

CHARLES V. MOORE has received his Ph.D. in the Department of Agricultural Economics and Rural Sociology at the Ohio State University and will assume a research position at the University of California, Davis.

W. H. M. MORRIS of the Agricultural Economics staff at Purdue is on leave July 1, 1959 to January 1, 1960 as a visiting member of the staff at the Max Planck Institute of Agricultural Work Science, Bad Kreuznach, West Germany.

WILLIAM G. MURRAY, Professor in the Department of Economics and Sociology at Iowa State University, has been granted a leave of absence during the fall of 1959 to tour Asian countries and visit universities in this area.

S. DANIEL NEUMARK has been made professor and economist in the Food Research Institute of Stanford University.

STERLING R. NEWELL, Director, Agricultural Estimates Division, AMS, received on May 26, 1959, the Distinguished Service Award for his vision and leadership in helping to provide the American farmer with the best agricultural statistics and marketing service to be found anywhere in the world.

PHIL OLSON has joined the staff of the Department of Sociology at the University of Connecticut, Storrs, after completing the requirements for the Ph.D. degree in Agricultural Economics at Purdue in the spring of 1959.

STANTON PARRY, Acting Head of the Department of Business at Bethany Nazarene College, has joined the staff of the Market Organization and Costs Branch, Marketing Research Division, AMS, for the summer to aid in developing research in dairy marketing.

JEROME K. PASTO, Associate Professor of Farm Management, returned to Penn State University on July 1 following a two-year leave of absence to serve with FAO in Rome.

ARNOLD A. PAULSEN, Assistant Professor in the Department of Economics and Sociology at Iowa State University, has been appointed to the research staff of the Agricultural Adjustment Center at Iowa State University.

HAZEN B. PINGREY, Professor of Agricultural Economics at New Mexico State University, retired on February 1, and succumbed to an attack of cancer on April 15, 1959. He had been on the University staff for 23 years. He received his B.S. degree from Colorado State University and M.S. degree from the University of Minnesota.

RONALD POLLOCK has resigned as instructor in the Department of Agricultural Economics and Rural Sociology at the Ohio State University to become assistant business manager of the university.

ANTONIO J. POSADA has been appointed Dean of the Faculty of Economic Sciences at the Universidad Del Valle, Cali, Colombia. He will also teach agricultural economics and economic theory.

OLIN QUINN, formerly Research Associate in Agricultural Economics at Louisiana State University, has been appointed Treasurer of the Federal Land Bank of New Orleans. He has been serving as Assistant Secretary-Treasurer of the Federal Intermediate Credit Bank.

MARK M. REGAN, Farm Economics Research Division, ARS, received a Superior Service Award at the recent Honor Awards Ceremony of the USDA, for meritorious research on the economic problems of land and water resource development which has resulted in adoption of improved procedures and practices in evaluation of resource projects."

FRED ROBERTSON has been named Assistant Director, Agricultural Extension Service at Alabama Polytechnic Institute at Auburn. He formerly was Assistant to the Director of Agricultural and Home Economics at Penn State University.

KENNETH L. ROBINSON of Cornell University will teach at the Farm Management Research Institute at Hokkaido University, Hokkaido, Japan, from July 10 to August 20, 1959. The institute is sponsored by the Council on Economic and Cultural Affairs.

GLENN P. ROEHRKASSEE, Assistant Professor of Agricultural Economics, University of Wyoming, is on sabbatical leave to continue his graduate work at Iowa State College.

EWELL P. ROY, has been promoted to Associate Professor at Louisiana State University, effective July 1, 1959.

RONALD S. RUST has accepted a position as Land Economist in the Dominion Department of Agriculture at Ottawa. He completed the requirements for the Ph.D. degree at the University of Illinois in June.

VERNON W. RUTTAN returned to Purdue July 1 following a year's work as a visiting member of the staff of the Giannini Foundation of Agricultural Economics at Berkeley, California.

ALLAN SCHMID who just completed his doctorate at the University of Wisconsin joined Michigan State University in June, as Assistant Professor. He will work in land economics.

G. EDWARD SCHUH, recently a graduate student at the University of Chicago, joins the Purdue staff in research and teaching production economics area September 1, 1959.

ROBERT SCHWART has resigned as Extension Specialist at Ohio State University in order to assume the position of associate professor of Farm Management at the University of Illinois.

BYRON T. SHAW, Administrator of the Agricultural Research Service, was recently honored by the Philadelphia Society for Promoting Agriculture with the Society's "1959 Agricultural Award for Outstanding Work in the Improvement of Agriculture."

OWEN K. SHUGARS joined the Washington staff of the Farm Economics Research Division, ARS, in April.

L. H. SIMERL, University of Illinois, participated in the European Seminar to study foreign trade problems and policies sponsored by the United States Department of Agriculture during May and June.

HAROLD D. SMITH has returned to the Department of Agricultural Economics at the University of Maryland after having spent a year in post doctoral study at the University of Chicago.

MERVIN G. SMITH, Chairman of the Department of Agricultural Economics and Rural Sociology at the Ohio State University, will serve as chairman of the ICA-sponsored seminar on agricultural marketing in Jamacia this summer.

JAMES S. ST. CLAIR has been promoted to the rank of Professor at the University of Wyoming.

O. C. STINE was visting professor in the Agricultural Industries Department, Southern Illinois University, during the 1959 Spring Quarter.

ROGER W. STROHBEHN joined the Washington staff of the Farm Economics Research Division, ARS, in April.

GEORGE B. STRONG will become Statistician in Charge of the Montgomery, Alabama Office on July 1, 1959 following the retirement of Mr. Garrett.

EARL R. SWANSON returned to the University of Illinois in June after spending the 1958-1959 academic year at the Royal College of Agriculture and Veterinary Medicine in Copenhagen, Denmark, under a Fulbright grant.

ANTHONY M. TANG will join the staff of the Institute of Social and Economic Research and the Department of Economics, Osaka University, Shibahara, Toyonaka, Osaka, Japan during 1959-60 while on leave of absence from Vanderbilt University.

KENNETH R. TEFERTILLER joined the staff of Texas Agricultural and Mechanical College on August 1 after completing the requirements for the Ph.D. degree at the University of Illinois.

GERALD I. TRANT has completed requirements for a Ph.D. degree at Michigan State University, and has joined the Department of Agricultural Economics, Ontario Agricultural College, Guelph as an Associate Professor.

GEORGE VON TUNGELN, who is completing his Ph.D. dissertation in Agricultural Economics at Pennsylvania State University, has accepted a position as Assistant Agricultural Economist in the Department of Agricultural Economics at the Clemson Agricultural College, Clemson, South Carolina.

EDWARD UVACEK recently resigned from the Washington staff of the Market Organization and Costs Branch, AMS, to accept a position with Armour and Company in Chicago.

LAWRENCE VANMEIR is leaving the staff at Kansas State College July 1. He will head the office of the Western Livestock Marketing Research Committee wih offices in Denver.

GLEN VOLLMER has been appointed farm management extension specialist at the Ohio State University.

J. J. WALLACE, Professor in the Department of Economics and Sociology at Iowa State University, returned in May from an 18 months position with the Point Four program to help establish a commercial farm management service in Chile.

ODELL L. WALKER, who recently completed the requirements for the Ph.D. degree at Iowa State College, has accepted a position as Assistant Professor of Agricultural Economics at Oklahoma State University.

S. V. WANTRUP will be on leave from the University of California until January 1960. He has accepted invitations to give a series of lectures on "The Economics of Conserving Energy Resources" at the Universite International de Sciences Comparees at Luxembourg. He also was invited by the Secretary of Agriculture of Western Germany to study problems of the water economy of Western Germany.

GORDON H. WARD has been appointed head of the Rural Improvement Division of the American University of Beirut. Graduate courses in Agricultural Economics are now being offered by the Faculty of Agricultural Sciences as part of a program leading to the Masters degree.

E. BOYD WENNERGREN, who recently completed requirements for a Ph.D. at Penn State University, has joined the staff at Utah State University as Assistant Professor of Agricultural Economics.

ROGER H. WILLSIE joined the Lincoln, Neb., staff of the Farm Economics Research Division, ARS, in April. He will work on a study of economic land classification techniques in the Great Plains with the University of Nebraska and interested Plains States.

GARLAND WOOD was promoted to Associate Professor at Michigan State University.

MARTIN D. WOODIN, formerly Head of the Department of Agricultural Economics at Louisiana State University, was appointed Director of Resident Instruction in the College of Agriculture at Louisiana State University on April 1, 1959.

MICHAL I. ZAWADZKI has left the University of Rhode Island to join the faculty of Loyola University as Assistant Professor in Economics.

A conference on the Economic, Political, and Human Aspects of Agricultural Development in Tropical Africa was held at Stanford University on May 21 and 22, under the sponsorship of the Food Research Institute. It was attended by 26 specialists in African studies from American universities and from Africa.

The four sessions of the conference were devoted to discussion of papers presented by: Melville J. Herskovits, Director of the Institute of African Studies, Northwestern University; George P. Murdock, Professor of Anthropology, Yale University; Paul J. Bohannon, Associate Professor of Anthropology, Princeton University; John N. Reedman, Assistant Director, Resources and Transport Economics Branch, United Nations; David E. Apter, Associate Professor of Political Science, University of Chicago; and S. Daniel Neumark, Bruce F. Johnston, and William O. Jones of the Food Research Institute.

Major topics discussed concerned the organization of agricultural production, patterns and trends in food consumption, the nature of African markets, the spread of the money economy, and governmental development policy.

The name of New Mexico College of Agriculture and Mechanic Arts has been changed to New Mexico State University. The post office name has been changed from State College to University Park, New Mexico.

The 31st Annual Meeting of the American Institute of Cooperation will be held at the University of Illinois, Urbana, August 9-12, 1959. The general theme of the conference, and one of the general sessions, will be "Gearing Cooperative to Serve Modern Agriculture." Other general sessions will include such topics as "Organizational and Financial Planning for Tomorrow," "The Challenge of Communications," and "Cooperatives–Enlight-

ened Capitalism." Many specialized subject matter areas will be covered in other sessions.

ADDITION OF GEORGE S. WEHRWEIN COLLECTION TO TAYLOR-HIBBARD CLUB LIBRARY

The late George S. Wehrwein, an early land economist at the University of Wisconsin, accumulated a library of rare and current books and periodicals on a variety of subjects. Since his death on March 10, 1945, Mrs. Anne Wehrwein has kept her husband's personal papers and library intact. In June of this year Mrs. Wehrwein contributed about 1,000 bound volumes and books to the Taylor-Hibbard Club Library maintained by the graduate students in the Department of Agricultural Economics at the University of Wisconsin. In addition, she gave Professor Wehrwein's personal papers to the Wisconsin Historical Society to be kept in the archives of the Historical Library. His personal works will be available there along with those of Professor Benjamin H. Hibbard, another pioneer in agricultural economics.

Professor Wehrwein's professional interests and investigations were very broad. They encompassed land economics, national land policy, land use problems in Northern Wisconsin, biblical history and the land economy of biblical times, and the history of the Great Lakes and their influence on life in this region. He combed and accumulated literature in each of these fields. The Wehrwein volumes contributed to the Taylor-Hibbard Club Library generally encompassed the material he had collected on land economics and local and national land use. More specifically the volumes had considerable depth in the area of transportation and settlement patterns, urban development, urban and rural land-use planning, rural zoning, public land management, national land policy, taxation, population, land value, rent, history of economic thought, history of agriculture and in political science.

The addition of the Wehrwein volumes to the Taylor-Hibbard Club Library supplements the Leonard A. Salter, Junior and the Benjamin H. Hibbard collections already held there. Approximately 600 volumes of Professor Salter's personal library were given to the Taylor-Hibbard Club by Mr. and Mrs. Leonard A. Salter and by the sisters of Gertrude C. Salter, his wife, following the tragic death of Professor Salter and his family. Unlike the Wehrwein collection, the Salter volumes constituted a working library and did not contain rare books on the political economy of rural and urban land resource use. Instead, the volumes encompassed current research publications, articles and books pertaining to land economics.

The Benjamin H. Hibbard volumes included not only land economics literature, but also encompassed literature on history of agriculture, agricultural policy, marketing and general agricultural economics. This contribution of approximately 500 volumes was given to the Taylor-Hibbard Club by Professor Hibbard's wife, Margaret B. Hibbard.

Together the Wehrwein, Salter and Hibbard contributions give the Taylor-Hibbard Club Library an outstanding collection of land economics literature. This collection will further teaching and research in agricultural economics at Wisconsin.

THE G. W. FORSTER LIBRARY

The purpose for creating the library was to make it convenient for students to have references to which they could refer quickly. This library was housed in the Department of Agricultural Economics and placed at their disposal. The books of the library were collected by the author, G. W. Forster by reviewing outstanding books. At first these were referred to him by the late Josephus Daniels of the News and Observer, and later by Jonathan Daniels. These books were the foundation of the Forster Library. This library was so unique in the History of Agricultural Economics and Farm Management, that many persons contributed books to it. Among these contributors was Dr. H. C. Taylor, who, not only has written some excellent books on Economics, but has travelled and studied abroad, especially in the Orient and Germany, where he was a Fellow at Halle-Wittenberg University. He was also a student in the London School of Economics and University of Berlin. His large collection of books has recently been received and deposited in the library.

In addition to the H. C. Taylor books the library of Dr. L. C. Gray has been added to the Forster library, thru his son Prof. John L. Gray, of State College. This collection includes many books written by Dr. Gray on pre-slavery conditions and Land Tenure problems.

The library of Dr. Rudolph Freund, former member of the Department of Agricultural Economics, has also been given to the library.

The library also includes numerous bulletins prepared by the author, as well as his books "Elements of Agricultural Economics" and "Farm Organization and Management."

MRS. G. W. FORSTER

ANNOUNCEMENT

The AFEA Employment Committee will provide placement service facilities for the summer meetings in Ithaca. Details have been sent to department heads and other prospective employers. Members who have not already obtained copies may request job order or application forms from Professor R. D. Aplin, Department of Agricultural Economics, Cornell University.

JOURNAL OF BUSINESS

Graduate School of Business, University of Chicago, Chicago 37, Illinois

Volume XXXII **JULY 1959** **Number 3**

The JOURNAL OF BUSINESS is published quarterly by the Graduate School of Business of the University of Chicago. Subscriptions are $6.00 per year and should be addressed to the JOURNAL OF BUSINESS, Graduate School of Business, University of Chicago. Editorial correspondence (manuscripts in duplicate) should be addressed to Irving Schweiger, Editor, JOURNAL OF BUSINESS at the same address.

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Applications for membership, **changes in address, or inquiries regarding the general affairs of the Association should be addressed to C. Del Mar Kearl, Department of Agricultural Economics, Cornell University, Ithaca, New York.**

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